THE DIATOMS (BACILLARIOIDEAE) OF NEBRASKA

BY

CLARENCE J. ELMORE

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A THESIS

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OCCURRENCE

Diatoms are found practically in all places where there is water—in lakes, rivers, creeks, ponds, tubs, troughs, tanks; and on damp ground, rocks, walls, or boards. All water, from the ocean to the smallest puddle caused by the tracks of cattle's feet, provided the puddles persist for a few days, is almost certain to contain diatoms. When unmixed with other substances they present a brownish color. Often the entire bottom of a stream may be covered to a thickness of an inch or more with a brown mass of diatoms. But the greater number occur mixed with other algae, in which case their brown color is hidden by the green of the algae.

Diatoms are also found in the fossil state. In this condition they are called Diatomite by geologists, or Kieselguhr in commerce. The name Infusorial Earth has also been applied to them, but this is incorrect, for diatoms are not Infusoria.

Diatoms differ from other plants in that their cell walls are thoroughly infiltrated with silica, or quartz of the opal variety. The form of the cell is often likened to a pill box or a telescope, one-half fitting over the other. The statement made in practically all of the textbooks is that when a cell divides the two valves, ends of the cell, separate slightly and a new valve grows inside of each, thus forming two new cells. Thus each new cell has one of the original valves of the mother cell and a new valve formed inside of the girdle of the old one. Hence it would appear that one of the new cells is the exact size of the mother cell and the other slightly smaller, the reduction in size going on with each cell division. This process continues until a certain minimum size is reached, when an auxospore is formed. The necessity for auxospore formation arises from the fact that the cell walls of diatoms are silicified and so can not grow, together with the fact that they become smaller with each division.

The simplest manner of auxospore formation is by the protoplasmic contents of a cell escaping from its siliceous shell and growing to the normal size for the species and then secreting a new shell about itself. Or in some cases two cells are formed in this way from a single mother cell. Another method is for the contents of two cells to escape and conjugate, forming in some cases one, and in other cases two, auxospores.

Since diatoms multiply with great rapidity, the diminution in size ought to require the very frequent formation of auxospores. But the actual condition is that they are of comparatively rare occurrence. The discrepancy arises from the fact that the foregoing description of a diatom is only partly true. In some cases the girdle of the old valve inside of which the new valve is formed enlarges so that the new valve is as large as, or larger than, the old one. In *Lysigonium* (*Melosira*), a genus in which the cells adhere together, long filaments are formed which are practically uniform in size. Otto Müller, *Die Zellhaut und das Gesetz der Zellteilungs folge von Meloseira arenaria Moore,* has shown that in this species the girdle is enlarged according to a regular law, so that the minimum size is very seldom reached. And according to this law only one auxospore is formed, where, if the diminution in size took place regularly, 1,052,100,000,000 would be formed. This easily accounts for the infrequent occurrence of auxospores in this species.

In *Fragilaria,* another genus in which the cells adhere in bands, the girdles can be seen meeting, but not overlapping, and in this genus, too, there is no apparent diminution in size of the filaments.

Diatomite, when pure, is a white or grayish substance so light that it floats on water. It is often mixed with other substances. In Nebraska it usually contains more or less calcium carbonate, the amount varying from a slight trace to so much that it becomes a hard limestone with comparatively few diatoms. The deposit from Greeley County, however, is practically pure. In our region, at least, it is not often mixed with other substances than calcium carbonate. Conditions favorable to the growth of diatoms were favorable to the growth of the organisms producing the carbonate, and conditions under which inorganic sediment was formed were

unfavorable to the growth of diatoms. It is likely, however, that some diatoms were growing when inorganic sediment was being formed, but in the large amount of this sediment they have been overlooked.

COLLECTING AND PRESERVING

Few directions are needed for collecting diatoms. Any vegetable growth in water or in damp places is likely to contain them. All that is necessary is to get the material in any way that is most convenient and to carry it in whatever may be at hand for the purpose.

When it is desired to preserve the protoplasmic contents of diatom cells, they may be placed in formaldehyde or other preservative in the same manner as other algae. For careful cytological work they may be killed in hot mercuric bichloride solution, and then, after washing and dehydrating, mounted in balsam.

The determination of species depends mostly on the siliceous shells and when they are collected for that purpose no preservative need be used. The material containing them may be wrapped in paper and allowed to dry. Diatoms preserved in this way are in no way inferior to those preserved by more careful methods for purposes of identification when it is only the shells that are to be examined.

MOUNTING

The markings on the shells are often very delicate and difficult to see. In many of the smaller species they can not be seen when in their natural condition and mounted in water. They are more easily seen when the protoplasm is removed from the shells. This may be removed by boiling in a test tube in nitric acid. This destroys the cell contents, leaving only the siliceous shells. Water is then added, and after the diatoms have settled it is poured off. This process is repeated until the acid is all removed. A drop of the liquid containing them is placed on a coverglass and allowed to dry.

The method usually used by the writer, however, is to dry a small portion of the material containing the diatoms on a coverglass and to heat until all of the organic material has been burned

out. By this method they may be prepared much more quickly than by treating with acid. When there is sufficient heat, as with a gas flame, the coverglass may be laid on a flat piece of iron (the writer has used the blade of an old table knife) and held in the flame. When first heated the material turns black. It should be heated until the blackness disappears. If the heat of the flame is not sufficient, as is likely to be the case with an alcohol lamp, it may be increased by the use of a blowpipe. If the coverglass is held on a piece of silver, it will heat much more readily, owing to the greater conductivity of the silver. For this purpose the writer has used an old silver quarter dollar with a hole in it, a wire being fixed in the hole for a handle. In using a blowpipe the flame should be directed on the under side of the metal on which the coverglass is lying and not directly on the coverglass.

Nearly all of the fossil diatoms found in Nebraska are mixed with limestone or some form of calcium carbonate. This must be removed, for there is often so much of it that the diatoms are hidden entirely. This may be done by treating with hydrochloric acid. The method is the same as that for using nitric acid except that it is not necessary to heat it.

When dried on the coverglass they may be mounted in Canada balsam, but the markings are seen much more easily if mounted in styrax.[1]

[1] Styrax can be procured only in the crude state and must be prepared for use. The first step in preparing it is to spread a thin coating of it on a pane of glass or a plate and allow it to dry until all of the water has been removed. It is then dissolved in a mixture of equal parts of benzine and alcohol, or sulphuric ether and absolute alcohol. The solution is then filtered through filter paper. If it is so thick that it will not pass through the filter paper readily, more of the alcohol and ether may be added. After filtering it is ready for use. A quantity may be made up at one time since it will keep indefinitely. A drop of the styrax is placed on the coverglass containing the diatoms. If it becomes opaque at first it must be allowed to stand until it becomes clear. This may require several hours. This clearing may be hastened by heating gently. When cleared it is placed on a slide. The slide should then be heated until the volatile portion of the styrax solution is driven off. This will cause bubbles under the coverglass and the heating should be continued until the bubbles cease to form. When cooled the bubbles will disappear.

The location of individual diatoms on the slide may be indicated by drawing a circle around each specimen on the coverglass. Sanford's Indelible Stamping ink has been found satisfactory for this purpose. It may be applied with a pen and does not run on the glass. When dry it is not much affected by the oil of an oil immersion objective. If there are several specimens marked on one slide, a diagram of the location of each may be drawn on the label, indicating each species by a number.

RELATIONSHIP

The systematic place of diatoms is a matter about which there has been much disagreement. They were formerly regarded as animals and placed among the Infusoria. They are now universally regarded as plants, but there seems to be no general agreement as to their relationship. The placing them among the Brown Algae was based merely on their color, which is probably only an accidental or perhaps a physiological resemblance and has no systematic significance. That they are a derived and not a primitive group is indicated by the fact that they appeared comparatively late in geological time, none being known earlier than the Devonian. And since their appearance very little change has taken place. It is possible that they have evolved through earlier periods without their siliceous cell walls, and suddenly, as if by mutation, their walls became silicified. Hence all of their earlier history is lost, and at their first appearance in geological time they had reached their present form.

Forms like *Lysigonium* (*Meloseira*) seem closely related to the unsilicified filamentous algae and are probably derived from them. And the round diatoms in which the cells are separate may be considered as the cells of a filament which have become separated.

In the filamentous diatoms that form ribbon-like bands, instead of cylindrical filaments we have the same structure except that the filaments have become flattened. And the single-celled long (flat) diatoms may be considered as the cells of such a filament broken apart.

Whatever views various botanists have as to the relationships of diatoms, they are nearly all agreed that diatoms and desmids are

closely related. By their mode of forming zygospores, desmids are closely related to the filamentous *Conjugatae, e.g., Spirogyra.* And some diatoms in their formation of auxospores have a form of conjugation very similar to that of desmids. For this reason it seems best to place both diatoms and desmids with the filamentous *Conjugatae* under the phylum *Zygophyceae,* making of the unsilicified groups a separate class and of the siliceous ones a class of equal rank, the *Bacillarioideae.*

THE USE OF THE TERM VARIETY

Diatoms vary so greatly in size and form between one auxospore stage and the next that the early collectors who based their species on size and form alone described as species many conditions that are mere stages in the life history of a single species. The size necessarily decreases with each cell division until an auxospore is formed, except in those genera whose valves do not overlap, because each new valve is formed inside of an old one. If one part of the girdle is thicker than the rest, the new valve formed inside this valve will be slightly constricted at this point; and this constricting process will continue, making the constriction deeper and deeper with each division until the next auxospore stage is reached. If the thickening is at the ends, the valves will grow proportionally shorter with each division. So some species occur in many conditions that have been described as distinct species. The earlier works recognized few varieties, making a separate species for each condition in which a species was found. Later writers have brought together many of these so-called species and called them varieties, or in some cases, forms. But the term variety can scarcely be applied to diatoms. The species of diatoms present the same varieties now that they did in Tertiary times; so if these varieties are thus fixed, they are not varieties, but species. And those that merely represent conditions between two auxospore stages are not entitled to a separate name any more than an oak tree two feet high deserves a name separate from the name given to an older tree of the same species.

It is only by a most thorough and careful study of any species that all of the forms in which it may appear can be determined.

This work has been done for very few species. Hence the assigning of any form to a place as a species or that of a mere form has been and still is a matter mainly of individual judgment, in very few cases supported by sufficient data.

For these reasons the term variety has been discarded in the present work except as it has been necessary to use it in referring to other descriptions. It is probable that future work will greatly reduce the number of species of diatoms.

DESCRIPTIONS AND DRAWINGS

Many of the descriptions have been adapted from other works, but in all cases so modified as to include any peculiarities found in our local forms. The drawings are all original except that of *Chaetoceros elmorei,* this one being taken from the drawing accompanying the original description by Professor C. S. Boyer. The drawings are of actual specimens and in no case has an attempt been made to represent generalized or typical forms. In diatoms the same species occurs in many forms, hence the large number of figures given for some species.

All of the localities where each species has been found are given. This forms a fair measure of the frequency of occurrence of any species.

The writer wishes to express his indebtedness to the late Professor C. E. Bessey and Professor E. H. Barbour, of the University of Nebraska, for advice and assistance in the work throughout; also to Professor C. S. Boyer, of Philadelphia, for the identification of several species as well as for many valuable suggestions. The work of Mrs. Eleanor Barbour Cook on a particularly rich deposit of diatomite at Agate, Nebraska, has been incorporated into this work, all of the species reported from Agate being from this collection and from one sent by Mr. Harold J. Cook.

The fossil material from Greeley County was collected in 1887 by Mr. Russell and given to Professor Bessey, who furnished it to the writer. That from other localities was furnished by Professor Barbour, some of it having been collected by Mr. A. C. Whitford, that from Thedford by Mr. J. N. Neely and Mr. J. M.

McMillan, and that from Merriman by Mr. L. E. Fagan. The collection from Loup City was furnished by Mr. Clarence O. Peterson, and that from Hay Springs by Prof. R. W. Ellis.

Much of the recent material has been collected by friends of the writer, among whom are: Prof. W. E. Allen, Fresno and Stockton, Calif.; Rev. J. M. Bates, Atkinson, Ewing, Long Pine, and Red Cloud; Prof. A. T. Bell, Crete; Prof. C. E. Bessey, Ashland; Miss Grace Bradburn (Mrs. Chas. Frisch), Broken Bow; Miss Pearl Chase, Ainsworth; Prof. F. E. Clements, Holt County; Miss Alba Cosner, New Helena; Miss Harriet Ege, Rosebud, S. Dak.; Miss Cora Elmore (Mrs. C. H. Bancroft), Talmage; Mr. Wm. Fleming, Cheyenne, Wyo.; Prof. J. H. Flodman, Wahoo; Miss Ethel Hansen, Grand Island; Mr. W. J. Hesser, Plattsmouth; Miss Isabel Johnston, Lodi; Mr. Ray Kellenbarger, Anselmo; Mr. E. F. Lange, Fairbury; Mr. Ray McCann, Estes Park, Colorado; Mr. Theodore Moline, Polk; Prof. A. K. Peiterson, Weeping Water; Prof. N. F. Petersen, many places in eastern Nebraska; Prof. Roscoe Pound, Sheridan County, Cherry County; Prof. J. H. Powers, Colorado; Prof. A. A. Reed, Crete; Mr. J. A. Reed, Blue Springs; Mrs. Perry Robbins, New Helena; Mr. Windom Rosene, Stromsburg; Prof. DeAlton Saunders, Bellevue; Miss Laura Sutherland, Chippewa Falls, Wis.; Miss Lilian Sutherland, Pawnee City; Miss Fae Troyer (Mrs. Wm. Fleming), Turtle River and Dallas, S. Dak.; Prof. J. E. Weaver, Crete; A. C. Whitford, Dismal River and many other places in the Sand Hills; Prof. Elda R. Walker, lakes in Sand Hills; Prof. R. T. Young, Devils Lake, N. Dak. Besides these much material from the vicinity of Grand Island has been furnished by members of the writer's own family.

Artificial Key to the Genera

A. Valves round.
  b. Cells without horns (Fam. *Coscinodiscaceae*).
    c. Cells united in filaments. 1. *Lysigonium*, page 36.
    cc. Cells single.
      d. With distinct central and marginal portions. 2. *Cyclotella*, page 39.
      dd. Central and marginal portions grading into one another.
        e. With marginal spines. 3. *Stephanodiscus*, page 40.

ee. Without marginal spines.
4. *Coscinodiscus,* page 41.
bb. Cells with horns (Fam. *Chaetocerataceae*).
5. *Chaetoceros,* page 42.
bbb. Cells with short processes. 6. *Biddulphia,* page 43.
AA. Valves linear, elliptical, oval, or sometimes irregular.
b. Valves with a pseudoraphe, *i.e.,* a clear longitudinal strip.
c. Cells in girdle view rectangular, nearly as broad as long (Fam. *Tabellariaceae*).
d. Transverse ribs of the valves when present not extending into the cell cavity.
e. Valves with a few heavy ribs.
7. *Tetracyclus,* page 44.
ee. Valves with striations, no ribs.
8. *Striatella,* page 45.
dd. Ribs seen in girdle view to extend deeply into the cell.
9. *Denticula,* page 46.
cc. Cells elongated in both valve and girdle view.
d. Cells wedge-shaped in girdle view (Fam. *Meridionaceae*).
e. Without transverse ribs.
10. *Sceptroneis,* page 47.
ee. With transverse ribs.
11. *Meridion,* page 48.
dd. Cells rectangular in girdle view, or if of other form, the rachis not median (Fam. *Fragilariaceae*).
e. Rachis median.
f. Valves with heavy ribs.
12. *Odontidium,* page 49.
ff. Valves with striations, no ribs.
g. Cells short; in filaments.
13. *Fragilaria,* page 51.
gg. Cells longer, forming fan-like stalked clusters.
14. *Synedra,* page 53.
ggg. Cells symmetrical, in radiating clusters.
15. *Asterionella,* page 57.
ee. Rachis near one margin.
f. Rachis nearly on ventral margin, not interrupting the striations. 16. *Eunotia,* page 57.
ff. Rachis somewhat removed from the ventral margin, interrupting the striations.
17. *Ceratoneis,* page 60.
bb. One or both valves with a raphe; cells usually elongated.
c. Rachis median or nearly so; valves not keeled (Fam. *Naviculaceae*).

d. Cells rectangular in girdle view.
e. Cells with striations and a row of transverse septa around the margins.
18. *Mastigloia,* page 61.
ee. Cells with striations but no septa.
f. Valves not keeled.
g. Raphe straight or nearly so.
h. No heavy lines bordering the raphe.
i. Cells straight in girdle view.
j. Central nodule round.
k. Face of valves flat; raphe straight.
19. *Navicula,* page 62.
kk. Face of valves convex; raphe slightly sigmoid.
20. *Scoliopleura,* page 94.
jj. Central nodule elongated transversely forming a stauros.
21. *Stauroneis,* page 95.
jjj. Central nodule elongated longitudinally into 4 horns.
22. *Diploneis,* page 97.
ii. Cells curved in girdle view; only one valve with a raphe.
j. Cells elongated.
23. *Achnanthes,* page 98.
jj. Cells nearly circular.
24. *Cocconeis,* page 100.
hh. Raphe bordered by two heavy lines giving the appearance of a double raphe.
25. *Brebissonia,* page 103.
gg. Raphe sigmoid.
26. *Gyrosigma,* page 104.
ff. Valves keeled. 27. *Amphiprora,* page 107.
dd. Cells wedge-shaped both in girdle and valve view.
e. Cells straight in girdle view.
28. *Gomphonema,* page 107.
ee. Cells curved in girdle view.
29. *Rhoicosphenia,* page 114.
ddd. Raphe arcuate; cells more or less moon-shaped.
e. Valves without transverse ribs.
f. Raphe and central nodules not close to the margins of the valves.

g. Terminal nodules near the ends, raphe more or less curved.
30. *Cymbella,* page 115.
gg. Terminal nodules usually distant from the ends, raphe straight.
31. *Encyonema,* page 122.
ff. Raphe and central nodule close to the ventral margin.
32. *Amphora,* page 124.
ee. Valves with transverse ribs; raphe not evident.
33. *Cystopleura,* page 125.
cc. Cells usually elongated; rachis usually on the margin of the valve, so that striations are not interrupted by it; valves with a dotted keel (Fam. *Bacillariaceae*).
34. *Homoeocladia,* page 130.
ccc. Cells usually oval or elliptical, seldom elongated; with two wings (Fam. *Surirellaceae*).
d. Valve surface undulate. 35. *Sphinctocystis,* page 145.
dd. Valve surface not undulate.
e. Valves cuneate, reniform, elliptical, or linear.
36. *Surirella,* page 147.
ee. Valves nearly circular, bent into saddle shape.
37. *Campylodiscus,* page 150.

Class Bacillarioideae

One-celled aquatic plants living in filaments, or more commonly broken into single cells; free, attached to the substratum, epiphytic on other plants, or enclosed in gelatinous tubes; cell wall of cellulose infiltrated with silica; the wall of each cell (frustule) consisting of two plates (valves) which form the ends of the cell and are connected by two or more girdles, the one fitting outside the other like the cover of a box. Protoplasm parietal and forming a large mass in the center of the cell in which the nucleus is located and which separates the central vacuole into two parts. Chromatophores plate-like or granular; chlorophyll obscured by a brownish coloring matter, phycoxanthin. In the elongated, free-swimming families, *Naviculaceae, Bacillariaceae,* and *Surirellaceae,* there is a longitudinal slit (raphe) which in *Naviculaceae* is median, or nearly so, and in the other families is lateral. Propagation by cell division in which each daughter cell retains one of the valves of the mother cell. Reproduction by the sexual or asexual formation of auxospores.

Systematic Key to the Families and Genera

A. Order *Eupodiscales.* Round Diatoms. Cells in cross section usually circular, less commonly polygonal, elliptical, and rarely irregular; valves marked concentrically or radially by dots, areolations, lines, or ribs; cells often with spines, processes, or horns.

b. Cells without horns. Family 1. *Coscinodiscaceae,* page 36.

bb. Cells with long horns or bristles. Family 2. *Chaetocerotaceae,* page 42.

bbb. Cells with shorter spines or processes. Family 3. *Biddulphiaceae,* page 43.

AA. Order *Naviculales.* Flat Diatoms. Filaments flattened, usually fragmented into single cells; cells narrowly elliptical to linear, less commonly broadly elliptical, lunate, cuneate, or irregular; valves marked pinnately or transversely by dots, areolations, lines, or ribs; cells (in our species) without spines, processes, or horns.

b. Rachis of the valves (*i.e.,* the line between the divergent pinnate markings) evident as a narrow, unmarked strip (pseudoraphe) rarely wanting; valve without a slit (raphe).

c. Cells usually little shorter than broad, or longer, with numerous interzones, mostly united in filaments. Family 4. *Tabellariaceae,* page 44.

cc. Cells usually much shorter than broad (rod-shaped of older authors, the longer axis of the rod representing one of the transverse axes of the cell), often united in filaments.

d. Cells cuneate in girdle view (*i.e.,* valves not parallel), rachis median, interzones present. Family 5. *Meridionaceae,* page 47.

dd. Cells rectangular in girdle view, or if cuneate, the rachis not median; interzones present or absent. Family 6. *Fragilariaceae,* page 49.

bb. Rachis containing an elongated slit (raphe) through the cell wall.

c. Rachis commonly median, often more or less lateral, not keeled, or when keeled not punctate; interzones present or absent. Family 7. *Naviculaceae,* page 60.

cc. Rachis lateral, less often median, punctate-keeled, raphe not plainly visible. Family 8. *Bacillariaceae,* page 130.

bbb. Rachis evident as a narrow, unmarked strip, or keeled, valve with two lateral wing keels, each enclosing a raphe. Family 9. *Surirellaceae,* page 145.

KEY TO THE GENERA

Order *EUPODISCALES*

Family 1. COSCINODISCACEAE

A. Cells forming filaments; girdle side marked.
1. *Lysigonium* (*Meloseira*), page 36.
AA. Cells single; girdle side not marked.
b. Valve with distinct central and marginal portions.
2. *Cyclotella,* page 39.
bb. Central and marginal portions of the valve grading into one another.
c. With marginal spines.
3. *Stephanodiscus,* page 40.
cc. Without marginal spines.
4. *Coscinodiscus,* page 41.

Family 2. CHAETOCEROTACEAE

5. *Chaetoceros,* page 42.

Family 3. BIDDULPHIACEAE

6. *Biddulphia,* page 43.

Order *NAVICULALES*

Family 4. TABELLARIACEAE

A. Transverse ribs of the valves, when present, not extending into the cell cavity.
b. Valves with a few prominent transverse ribs.
7. *Tetracyclus,* page 44.
bb. Valves tranversely striate.
8. *Striatella* (*Tabellaria*), page 45.
AA. Transverse ribs of the valves extending deeply into the cell cavity.
9. *Denticula,* page 46.

Family 5. MERIDIONACEAE

A. Valves punctate or variously punctate-striate, without transverse ribs.
10. *Sceptroncis* (*Opephora, Peronia*), page 47.
AA. Valves finely striate and with transverse ribs.
11. *Meridion,* page 48.

Family 6. FRAGILARIACEAE

A. Rachis median.
b. Valves with transverse ribs, or if not ribbed, with a central clear space (pseudoocellus).
12. *Odontidium* (including *Diatoma*), page 49.

bb. Valves without transverse ribs and without central clear space.
c. Cells in filaments.
13. *Fragilaria*, page 51.
cc. Cells single or forming fan-like, stalked clusters.
14. *Synedra*, page 53.
ccc. Cells in radiating clusters.
15. *Asterionella*, page 57.
AA. Rachis near one margin.
b. Rachis nearly on ventral margin, not interrupting the striations.
16. *Eunotia*, page 57.
bb. Rachis somewhat removed from ventral margin, interrupting the striations.
17. *Ceratoneis*, page 60.

Family 7. NAVICULACEAE

A. Valves parallel.
b. Frustules with marginal septa.
18. *Mastigloia*, page 61.
bb. Frustules without marginal septa.
c. Rachis of valves not keeled.
d. Raphe straight or nearly so.
e. Raphe with a simple border.
f. Septa of interzones when present not fenestrated.
g. Cells straight in girdle view.
h. Central nodule round.
i. Valves flat, raphe straight.
19. *Navicula*, page 62.
ii. Valves convex; raphe slightly sigmoid.
20. *Scoliopleura*, page 94.
hh. Central nodule elongated transversely, forming a stauros.
21. *Stauroneis*, page 95.
hhh. Central nodule elongated longitudinally into four horns.
22. *Diploneis*, page 97.
gg. Cells curved in girdle view.
23. *Achnanthes*, page 98.
ff. Septa of interzones fenestrated; only one valve with a raphe.
24. *Cocconeis*, page 100.
ee. Raphe bordered by two ridges.
25. *Brebissonia*, page 103.
dd. Raphe strongly sigmoid or arcuate.
26. *Gyrosigma* (*Pleurosigma*), page 104.

cc. Rachis of valves with a keel.

27. *Amphiprora*, page 107.

AA. Valves not parallel; ends approximating.

b. Cells straight in girdle view.

28. *Gomphonema*, page 107.

bb. Cells curved in girdle view.

29. *Rhoicosphenia*, page 114.

AAA. Valves not parallel; edges approximating.

b. Valves without transverse ribs.

c. Girdle narrow, not striate.

d. Terminal nodules near apices; raphe more or less arcuate.

30. *Cymbella*, page 115.

dd. Terminal nodules distant from the apices; raphe straight.

31. *Encyonema*, page 122.

cc. Girdle broad, striate.

32. *Amphora*, page 124.

bb. Valves with transverse ribs; raphe not evident.

33. *Cystopleura* (*Epithemia*), page 125.

Family 8. BACILLARIACEAE

34. *Homoeocladia* (*Nitzschia*), page 130.

Family 9. SURIRELLACEAE

A. Valve surface undulate.

35. *Sphinctocystis* (*Cymatopleura*), page 145.

AA. Valve surface not undulate.

b. Valves cuneate, reniform, elliptical, or linear.

36. *Surirella*, page 147.

bb. Valves sub-circular, saddle-shaped.

37. *Campylodiscus*, page 150.

Family 1. COSCINODISCACEAE

Cells short and disc-like, or the length sometimes three or four times the diameter; ends striate or punctate, not ribbed. Cells in long filaments or separated into single cells; often with short spines, but no horns. Chromatophores of numerous minute plates.

Lysigonium

Lysigonium Link in *Nees Hor. phys. berol., p. 4. 1820.*

Etym., Gr. λύσιος, dissolving, and γόνια, joints, from the appearance of the filaments which resemble filamentous algae, but break apart early.

Meloseira Ag. *Syst. Alg., p. 14. 1824.*

Cells spherical to cylindrical, closely united in filaments; valve view circular, simply punctate. Chromatophores small rounded or irregular plates which are distributed irregularly on the wall of the cell. Auxospore formation asexual. One enlarged daughter cell is produced from one mother cell; cell axis of the daughter cell is parallel or perpendicular to that of the mother cell. In the first case the daughter cell remains within the mother cell and separates the mother chain.

A. Junction surfaces of the cells convex. 1. *L. varians.*
AA. Junction surfaces of the cells plane, often denticulate.
b. Cells with a sulcus near the sutural margin.
c. Length of the cells usually not much greater than the width; with distinct granules. 2. *L. distans.*
cc. Length of the cells usually greater than the width; with fine granules. 3. *L. crenulatum.*
bb. Cells without a sulcus on each side of the connecting zone. 4. *L. granulatum.*

1. **Lysigonium varians** (Ag.) D. T. *Alg. Alg. Abyss. 1891.*
Meloseira varians Ag. *Consp. 1830.*

Pl. 1, figs. 1–5.

Cells in pairs; ends of cells convex, covered with fine puncta between which are some coarse dots; sides of cells with fine puncta intermixed with some coarser dots, with a row of coarse beads near the margin; connecting zone between two cells finely striate. Sporangial cells almost globular (figs. 3–5). Diameter 8–35 μ. A form 4–5 μ in diameter seems to belong to this species.

In creeks, rivers, ponds, ditches, lakes, etc. Andrews, Anselmo, Burge, Callaway, Cedar Creek, Central City, Cody Lake, Crawford, Dismal River, Dunning, Emerald, Emmett, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Hyannis, Ithaca, Lakeside, Lincoln, Long Pine, Melia, Milford, New Helena, Newport, Norfolk, Orella, Pelican Lake, Red Cloud, Ruby, Seward, South Bend, St. Michael, St. Paul, Stanton, Tekamah, Thedford, Valentine, West Point, Whitman.

Fossil: Agate, Greeley County, Hay Springs, Loup City, Merriman, Spalding, Thedford, Williams's Canyon.

Chippewa Falls, Wis.; Blackpipe, Conata, Little White River, Rapid City, S. Dak.; Stockton, Cal.; Blackhand, Granville, New Concord, Put-in Bay, Ohio.

2. **Lysigonium distans** (Kütz.) Kuntze. *Rev. Gen. Plant., II, p. 902. 1891.*

Meloseira distans Kütz. *Bacill., p. 54, pl. 2, fig. 12. 1844.*

Pl. 1, figs. 6–10.

End of cell flat, 4–20 μ in diameter, covered with large scattered dots; sides of cell covered with granular striations, 13–14 in 10 μ, slightly spiral; ends of cell with a row of marginal spines. End view shown in fig. 10.

Among moss with *Spirogyra* at Snake River Falls, Culbertson; with other algae at Oakdale, Scottsbluff, Valentine.

Fossil: Agate.

Stockton, Cal.

3. **Lysigonium crenulatum** (Kütz.) Kuntze. *Rev. Gen. Plant., II, p. 902. 1891.*

Meloseira crenulata Kütz. *Bacill., p. 55, pl. 2, fig. 8. 1844.*

Gallionella crenulata Ehr. *Verb., pl. 2, fig. 41. 1843.*

Pl. 1, figs. 11–13.

End of cell plane, finely punctate, puncta scattered; margins showing well-marked teeth; cells much longer than broad, showing near the end of the cell a faint sulcus; sides of the cell striate, with striations usually somewhat oblique, about 18 in 10 μ, consisting of somewhat elongated puncta. Diameter, 2.5–20 μ; length of cell, 12–17 μ.

Crawford, Oakdale, St. Paul, Snake River, Thedford, Wann.

Fossil: Loup City.

Belvidere, Blackpipe, S. Dak.; Stockton, Cal.

4. **Lysigonium granulatum** (Ehr.) Kuntze. *Rev. Gen. Plant., II, p. 902. 1891.*

Gallionella granulata Ehr. *Verb., p. 127. 1843.*

Meloseira granulata Ralfs in *Pritch. Inf., p. 820. 1861.*

Pl. 1, figs. 14–15.

End of cell plane with large granules, scattered, indistinct; margin much indented; cells without sulcus, elongated, the sides with very coarse, distinct granules arranged in longitudinal lines, 7–9 in 10 μ. Diameter, 5–17.5 μ.

In ponds, lakes, creeks, etc. Atkinson, Brownlee, Chadron, Dewey Lake, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Pelican

Lake, Red Cloud, Seneca, Valentine.
Fossil: Thedford.
Turtle River, S. Dak.

2. Cyclotella

Cyclotella Kütz. *Bacill., p. 50. 1844. Syn. Diat., p. 7. 1833.* (Only as a division, not as a generic name.)

Etym., diminutive of Greek κύκλος, circle.

Cells usually single or in pairs, not in filaments, short-cylindrical, disciform, hence usually seen in end view, divided into two parts, the outer with more or less fine, smooth or punctate striations, sometimes with scattered spines, without dots, or irregularly punctate; the central part sometimes swollen. Girdle face straight or undulate. Auxospores formed asexually, single from one mother cell.

A. Margin strongly striate and center coarsely punctate. 1. *C. striata.*
AA. Not with marginal striations and coarsely punctuate center.
b. Center with triangular dots. 2. *C. antiqua.*
bb. Center without triangular dots.
c. Marginal striations mixed with heavier striations at regular intervals. 3. *C. comta.*
cc. Striations all alike. 4. *C. meneghiniana.*

1. **Cyclotella striata** (Kütz.) Cl. & Grun. *Arct. Diat., p. 119. 1880.*

Coscinodiscus striatus Kütz. *Bacill., p. 131, pl. 1, fig. 8. 1844.*

Pl. 1, fig. 22.

End of cell with distinct marginal ring, 5–6 μ wide, of coarse striations, 7–12 in 10 μ; diameter of cells, 30–80 μ.

In Devils Lake, N. Dak.

2. **Cyclotella antiqua** W. Sm. *Brit. Diat., I, p. 28, pl. 5, fig. 49. 1853.*

Pl. 1, fig. 17.

Cells 15–30 μ in diameter; end of cell with distinct marginal ring of costae, 2–3 μ wide; costae intermixed with spines or coarse dots, about 15 costae and 6 dots in 10 μ; center finely granular with 6–15 triangular elevations.

Grand Island.

3. **Cyclotella comta** (Ehr.) Kütz. *Spec., p. 20. 1849.*
Discoplea comta Ehr. in *Ber. Berl. Akad., p. 267. 1842.*
Pl. 1, fig. 18.

End of cell plane with a distinct narrow ring of striations around the margin; striations about 15 in 10 μ, each third or fourth striation much heavier than the others; central portion with radiating puncta, about ten rows in 10 μ at outside margin of central portion; diameter of cell, 7.5–40 μ. The form described as var. *radiosa* Grun. in *V. H. Diat., p. 447, pl. 22, fig. 654,* agrees fully with the specimens found.

In creek, Anselmo.
Devils Lake, N. Dak.

4. **Cyclotella meneghiniana** Kütz. *Bacill., p. 50, pl. 30, fig. 68. 1844.*
Pl. 1, figs. 19–21.

End of cell undulate with robust marginal striations, delicately punctate; central portion 5–10 μ in diameter, with fine radiating dots and one or two coarse dots almost in the center; striations 7–9 in 10 μ; diameter of cell, 10–24 μ.

In springs, creeks, ponds, etc., with higher algae: Benkleman, Broken Bow, Cedar Creek, Central City, Clear Lake, Cody Lake, Crawford, Dismal River, Dunning, Emerald, Fremont, Gordon Creek, Grand Island, Hyannis, Halsey, Lakeside, Lincoln, Lodi, Louisville, Melia, Milford, New Helena, North Platte, Northport, St. Paul, Scottsbluff, Seneca, Seward, Stanton, Stromsburg, Talmage, Tekamah, Thedford, Valentine, Wann, Weeping Water, West Point.

Fossil: Cherry County, Hay Springs, Loup City, Thedford.

Blackpipe, Kadoka, Norris, Rosebud, Weta, S. Dak.; fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Muskingum River, Put-in Bay, pond on island in Lake Erie, Ohio.

3. Stephanodiscus

Stephanodiscus Ehr. in *Berl. Akad., p. 80. 1845.*

Etym., Gr. στέφανος, crown, and δίσκος, disk, from the crown-like appearance of the cells.

Valves circular, somewhat convex, marked with granules arranged radially; spaces between the rows of granules hyaline; center hyaline or granular; margin with a single row of spines.

A. Marginal dots elongated like ribs. 1. *S. carconensis.*
AA. Marginal dots not elongated; striations extending nearly to the center. 2. *S. niagarae.*

1. **Stephanodiscus carconensis** (Eulenst.) Grun. *Diat. Kasp. Meer., p. 128. 1878.*

Pl. 1, fig. 23.

Cell disk-shaped, plane, 30–40 μ in diameter; striations about 15 in 10 μ, granular, radiating, the center filled with scattered granules; marginal dots elongated like ribs, about 6 in 10 μ; margin with a row of spines.

Devils Lake, N. Dak.

2. **Stephanodiscus niagarae** Ehr. in *Ber. Berl. Akad., p. 80. 1845.*

Pl. 1, figs. 24–25.

Cells disk-shaped, plane, 25–60 μ in diameter, striations granular, about 16 in 10 μ, radiating, extending nearly to the center, the center filled with scattered granules; the margin with a row of spines, about 4 in 10 μ.

Benkleman.
On rocks in creek, Cheyenne, Wyo.

4. Coscinodiscus

Coscinodiscus Ehr. in *Abh. Berl. Akad., p. 128. 1838.*
Symbolophora Ehr., 1844; *Odontodiscus* Ehr., 1845; *Heterostephania* Ehr., 1854; *Cestodiscus* Grev., 1865; *Cosmiodiscus* Grev., 1866; *Stoschia* Janisch, 1885.

Etym., Gr. κόσκινον, sieve, and δίσκος, disk.

Cells single, circular, or sometimes elliptical; ends (valves) flat, concave, or swollen; no ribs, septa, or processes except sometimes very small teeth.

Coscinodiscus lacustris Grun. in *Cleve & Grun. Arct. Diat., p. 114. 1880.*

Pl. 1, fig. 26.

Circular or sometimes broadly oval, 20–70 μ in diameter; puncta radiating, in double rows on the margin, becoming single toward the center, 4–5 rows in 10 μ on the margin, some of the rows

extending to the center, leaving no central space; teeth fine, about 6 in 10 μ.

In Platte River, Grand Island; Put-in Bay, pond on island in Lake Erie, Ohio.

In San Joaquin River, Stockton, Cal.

Family 2. CHAETOCERATACEAE

Cells short, usually in filaments, cylindrical or flattened. Valves alike, terminated by a hood, pointed with a bristle; or frustules with valves unlike, mostly smooth; furnished with awns, horns, spines, or setae; often imperfectly siliceous; with a long central spine.

5. Chaetoceros

Chaetoceros Ehr. in *Ber. Berl. Akad., p. 198. 1844.*

Bacteriastrum Shadb., 1853; *Actiniscus* Ehr., 1854.

Etym., Gr. χαίτη, bristle, and κέρας, horn, referring to the long awns.

Valves convex, elliptic or circular with very long awns; cells usually united in long cylindrical filaments.

Chaetoceros elmorei Boyer, *A New Diatom*, in *Proceedings of The Academy of Natural Sciences of Philadelphia, p. 219. March, 1914.*

Pl. 1, figs. 27–33.

Filaments straight, 23 μ wide. Cells rectangular with sharp angles; valves slightly convex; foramina narrowly linear, irregular, bipartate. Setae straight, hollow, approaching each other at an acute angle and crossing at a right angle near the corners of the valves, about ten times the length of the valve. In valve view they diverge from each other at an angle of about 80°. Terminal setae shorter than the others, somewhat curved in the direction of the filament. Spores with the primary valve arcuate, secondary valve produced into a subconical frustum. Rarely in free spores the primary valve is covered with minute spines. The valves are joined together near one side by a tubular commissure, from six-tenths to eight-tenths of a micron in thickness, situated near the edge of the valve, usually at unequal distances from each end, and,

so far as noticed, is found near the margin on the same side of all valves of the filament. (Professor Boyer's original description.)

With crustaceans in surface tow, Devils Lake, N. Dak.

Family 3. BIDDULPHIACEAE

"Cells box-shaped, shorter than broad, or but little longer, transection circular, polygonal, or commonly elliptical; valves with two (rarely one) to more poles, each pole with a projection or horn which is shorter than the cell, or when about its length provided with claws; interzones rarely present."

6. Biddulphia

Biddulphia Gray in *Arrang. Brit. Plants, I, p. 294. 1831.*

Etym., named after a Miss Biddulph.

"Frustules free or united into filaments, either continuous or in zigzag. Valves elliptic, suborbicular, triangular, quadrangular, etc.; margins even or undulated, usually more or less inflated in the median portion, rarely depressed, showing elevated obtuse processes at the apices, and having also sometimes horn-like processes. Girdle face more or less quadrangular, showing distinctly processes which are not so visible in the valve face. Connective zone very obvious."

Biddulphia laevis Ehr. *Ber., p. 122. 1843.*

Pl. 22, figs. 811–812.

"Valve suborbicular or broadly elliptic, bearing near the longitudinal axis two spines, opposite, short, obscure, with punctate radiate striae, somewhat undulate as if engine-turned, delicate, about 15 or 16 in 10 μ, intermixed with abbreviated scattered spines. Girdle face with terminal processes, very short, obtuse, truncate, punctate up to the margin. Connecting zone with delicate striae, about 16 in 10 μ, punctate in quincunx. Length of valve, 50–120 μ." In our specimens the spines are indistinct or lacking.

In Middle Loup River at Dunning and Thedford.

Order *NAVICULALES*

Family 3. TABELLARIACEAE

Rachis a narrow unmarked strip, no raphe, cells usually little shorter than broad, or longer, mostly in filaments; valves symmetrical, long-elliptic, often swollen in the middle, never cuneate at the ends; with two or more septa; girdle face rectangular.

7. Tetracyclus

Tetracyclus Ralfs in *Ann. and Mag. Nat. Hist., Vol. XII. 1843.*

Etym., Gr. τέτρα, four, and κόκλος, circle, the valve being divided into four circular portions.

Cells tabulate, united in short bands by numerous interzones; with somewhat distant and irregular transverse ribs which in girdle view appear as marginal teeth; without nodules; girdle view rectangular; chromatophores granular, scattered.

A. Cells inflated in the middle. 1. *T. lacustris.*
AA. Cells elliptical, without inflation. 2. *T. rupestris*

1. **Tetracyclus lacustris** Ralfs in *Ann. and Mag. Nat. Hist., Vol. XII, p. 105, pl. 2, fig. 2. 1843.*

Pl. 1, figs. 34–35.

Cells in valve view elongated, much swollen in the middle, 35–65 μ long; transverse ribs 4–12, curved toward the center; striations very indistinct, 25–30 in 10 μ; the girdle side with alternate short ribs; cells in long filaments showing numerous septa.

In moss at Snake Creek Falls, Valentine.
Fossil: Greeley Co., Williams's Canyon.

2. **Tetracyclus rupestris** (A. Br.) Grun. *Oest. Diat., p. 412, pl. 7, fig. 37. 1882.*

Gomphogramma rupestre A. Br. in *Rabenh. Süssw. Diat., p. 33, pl. 9, fig. 1. 1853.*

Pl. 1, fig. 36.

Cells in valve view elliptic-lanceolate, 8–25 μ long, usually with 2–5 heavy transverse ribs; striations very delicate, about 18 in 10 μ; cells single or two or three united, in girdle view usually

showing two pairs of septa extending nearly to the middle of the cell.

With *Chara* in creek, Grand Island.

8. **Striatella** (*Tabellaria*)

Striatella Ag. *Consp. Diat., p. 60. 1832.*

Etym., diminutive of Lat. *stria,* striations, on account of the conspicuous striations.

Tabellaria Ehr. in *Ber. Berl. Akad., p. 217. 1840.*

Cells in girdle view rectangular, tabulate; at first attached and joined in bands, soon separated and united at the angles by a gelatinous isthmus; with plane dissepiments, usually alternate; in valve view cells more or less inflated at the ends and in the middle, transversely striate, without costae. Endochrome granular, scattered. Auxospores two, arising from a single mother cell.

A. Median inflation much broader than the terminal, septa numerous. 1. *S. flocculosa.*

AA. Median and terminal inflations equal, septa two to four. 2. *S. fenestrata.*

1. **Striatella flocculosa** (Roth) Kuntze. *Rev. Gen. Plant., III, 2, p. 432. 1898.*

Conferva flocculosa Roth. *Catal., I, p. 292, pl. 4, fig. 4. 1797.*

Tabellaria flocculosa (Roth) Kütz. *Bacill., p. 127, pl. 17, fig. 21. 1844.*

Pl. 1, fig. 37.

Cells linear, 20–40 μ long, middle inflated more than the ends; striations punctate, about 13 in 10 μ, lacking in the central inflation; pseudoraphe narrow; girdle face narrow, showing numerous (4–8) false septa.

Thedford.

2. **Striatella fenestrata** (Kütz.) Kuntze. *Rev. Gen. Plant., III, 2, p. 432. 1898.*

Tabellaria fenestrata Kütz. *Bacill., p. 127, pl. 17, fig. 22. 1844.*

Pl. 1, figs. 38–39.

Cells linear, 50–100 μ long, middle and apices nearly equally inflated; pseudoraphe narrow, dilated at the inflations; striations

punctate, 10–12 in 10 μ; girdle face narrow, showing from 2 to 4 false septa.

Atkinson.
Fossil: Mullen.
Chippewa Falls, Wis.; Stockton, Cal.

9. Denticula

Denticula Kütz. *Bacill., p. 43. 1844. em. Grun. in Wien. Verh., XII, p. 546. 1862.*

Etym., diminutive of Lat. *dens,* tooth, on account of the tooth-like ribs.

Valves lanceolate, without raphe, with a row of transverse septa appearing like ribs, between which are transverse granular or pearl-like striations; rectangular in girdle view; transverse ribs capitate, reaching to the girdle; cells free, single or united in short filaments.

A. Apices obtuse. 1. *D. elegans.*
AA. Apices acute. 2. *D. tenuis.*

1. **Denticula elegans** Kütz. *Bacill., p. 14, pl. 17, fig. 5. 1844.*
Pl. 2, figs. 40–43.

Cells linear-lanceolate with apices obtusely rounded, 20–35 μ long; carina obscure; 2.5–5 costae in 10 μ; striations distinct, coarsely punctate, 15–17 in 10 μ; girdle face very broad, rectangular with rounded angles showing the capitate apices of the costae. A curved form is shown in fig. 41.

With *Spirogyra,* etc.: Andrews, Anselmo, Benkleman, Cairo, Clear Lake, Crawford, Dunning, Grand Island, Lakeside, Long Pine, North Platte, Northport, Rupert, St. Paul, Seneca, Sheridan County, Snake River, Thedford, Trenton, Valentine.
Fossil: Agate, Cherry County, Mullen.
Blackpipe, Cutmeat, Rosebud, Turtle River, S. Dak.; Devils Lake, N. Dak.; Cheyenne, Wyo.

2. **Denticula tenuis** Kütz. *Bacill., p. 43. 1844.*
Pl. 2, figs. 44–46.

Cells lanceolate, 15–45 μ long, with apices attenuate to rostrate; carina conspicuous; costae 3–8 in 10 μ; striations fine, 15–17 in

10 μ. The specimens found agree more nearly with *D. inflata* W. Sm., which is probably only a form of *D. tenuis*.

In creek, western Colorado.

Family 5. MERIDIONACEAE

Rachis a narrow unmarked strip, no raphe; cells usually much shorter than broad, usually in filaments, cuneate in girdle view.

10. **Sceptroneis** (*Opephora, Peronia*)

Sceptroneis Ehr. in *Ber. Berl. Akad., p. 264. 1844.*

Etym. from Gr. σκῆπτρον, scepter, on account of the rod-like form of the valve.

Cells both in valve and girdle view cuneate, united; without septate girdle or transverse septa; pseudoraphe present, often very broad; terminal nodules sometimes present; valves with transverse beaded striations, beads often united into slit-like or button-hole-like striations.

A. With heavy ribs. 1. *S. pacifica.*
AA. With delicate striations. 2. *S. fibula.*

1. **Sceptroneis pacifica** (Grun.) Elmore.

Fragilaria pacifica Grun. in *Wien. Verh., p. 373, pl. 5, fig. 19. 1862.*

Opephora pacifica (Grun.) Petit. *Diat. Cape Horn, p. 130. 1888.*

Pl. 2, figs. 47–50.

Cells ovate, 20–30 μ long, with very heavy linear-ovate ribs, 5–10 in 10 μ; pseudoraphe narrow.

In ponds, rivers, etc., also fossil: Andrews, Benkleman, Brownlee, Burge, Crawford, Culbertson, Dismal River, Dunning, Fremont, Gordon Creek, Grand Island, Haigler, Halsey, Ithaca, Long Pine, Melia, Norfolk, North Platte, Oakdale, Red Cloud, St. Michael, St. Paul, Seneca, Snake River, Stanton, Valentine, Wann, West Point, Whitman.

Fossil: Greeley County, Mullen, Spalding, Thedford, Valentine.

Blackpipe, Little White River, Rosebud, S. Dak.; Cheyenne, Wyo.; Rodney, Ohio.

2. **Sceptroneis fibula** (Breb.) Schütt in *Eng. & Prant. Natur. Pflanz., I, Ib, p. 109. 1900.*

Gomphonema fibula Breb. in *Kütz. Spec. Alg., p. 65. 1829.*
Peronia erinacea Breb. & Arnott in *Micr. Jour., p. 16. 1868.*
Sceptroneis erinacea (Breb. & Arnott) Schütt *l.c.*
Pl. 2, figs. 51–53.

Cells cuneate both in valve and girdle view with upper end capitate, 40–50 μ long; terminal nodules distant from the ends; striations rather broad but indistinct, 15–16 in 10 μ, every fourth or fifth striation heavier than the others, interrupted by a pseudoraphe; girdle face with marginal striations; many of the cells variously distorted, as in fig. 52; stipitate, single or from two to four cohering.

Phalaris Lake, and in rapidly-flowing water at Long Pine, Tekamah. Conata, Norris, S. Dak.

11. Meridion

Meridion Ag. *Syst. Alg., p. XIV, 2. 1824.*
Etym. from Gr. μερίζω, divide.
Eumeridion Kütz. *Bacill., p. 42. 1844.*
Oncosphenia Ehr. in *Ber. Berl. Akad., p. 72. 1845.*

Cells resembling *Denticula;* valves with transverse septa between which are delicate granular striations, the striations but not the septa interrupted by a clear space (pseudoraphe) which is very delicate and often very difficult to distinguish; general form in valve view linear-lanceolate with the modification that it tapers in wedge form from apex to base; ends rounded, the larger end often capitate by a neck-like constriction just below the pole; cells in girdle view wedge-shaped with straight margins and truncate ends, the septa and striations extending to the girdle. After division the cells remain attached to each other so that the cells form filaments which vary according to the number of cells from fan-shape to circular. When a large number are formed the filament is wound spirally around the central axis. In the filament the septa of neighboring cells correspond with one another so that in the filament the septa form unbroken concentric lines. Filaments floating free. Chromatophores numerous, small.

Meridion circulare Kütz. *Bacill., p. 41, pl. 7, fig. 16. 1844.*

Pl. 2, figs. 54–56.

Cells oval, lanceolate, or clavate, 25–35 μ long, with apices rounded, obtuse; about 16 striations and 3 ribs in 10 μ; pseudoraphe indistinct; girdle face cuneate, with margins somewhat undulated by the beginning of the ribs; cells united in a spiral filament. *Meridion constrictum* Ralfs seems to be merely a form of *M. circulare,* all gradations between the two being found.

In creeks, springs, etc., also fossil: Ashland, Central City, Dunning, Gordon Creek, Halsey, Long Pine, St. Paul, Thedford.

Fossil: Agate, Merriman, Mullen, Williams's Canyon.

Chippewa Falls, Wis.; Conata, Little White River, Rapid City, S. Dak.; Sully's Hill, N. Dak.; Blackhand, Granville, New Concord, Rio Grande, Rodney, Ohio.

Family 6. FRAGILARIACEAE

Rachis a narrow unmarked strip, no raphe; cells generally shorter than broad; often in filaments, or sessile and nearly separated, adhering together at one end, forming fan-shaped colonies; generally rectangular in girdle view.

12. Odontidium

Odontidium Kütz. *Bacill., p. 44. 1844. em. Kirchn. Alg. Schles., p. 204. 1878.*

Diatoma DC. *Fl. Franc., II, p. 48. 1805. em. Heib. Consp. Diat. Dan., p. 55. 1863.*

Etym., Gr. ὀδούς, tooth, and ἴδιος, like, from the tooth-like appearance of the ribs.

Cells united in short bands or zigzag chains which are attached at the base; valves lanceolate to linear with transverse ribs and fine transverse striations, the latter interrupted centrally by an indistinct pseudoraphe; no central nodule; chromatophores granular.

A. Costae delicate; cells united in zigzag chains.
- *b.* Broadly lanceolate. — 1. *O. vulgare.*
- *bb.* Linear with ends capitate. — 2. *O. elongatum.*

AA. Costae coarse; cells in short filaments.
- *b.* Ends rounded. — 3. *O. hiemale.*
- *bb.* Ends capitate or rostrate. — 4. *O. anceps.*

1. **Odontidium vulgare** (Bory) Elmore.
Diatoma vulgare Bory. *Class. Dict., pl. 20, fig. 15. 1828.*
Pl. 22, figs. 813–814.
Cells broadly lanceolate to almost elliptical, sometimes slightly produced at the apices; 40–60 μ long, 10–14 μ wide; ribs 5–7 in 10 μ, striations finely granular, 14–16 in 10 μ; pseudoraphe indistinct; cells united in zigzag chains.

In Wood River at Grand Island.
Put-in Bay, Pond on Island in Lake Erie, Ohio.

2. **Odontidium elongatum** (Ag.) Kuntze. *Rev. Gen. Plant., III, 2, p. 418. 1898.*
Diatoma elongatum Ag. *Syst. Alg., p. 4. 1824.*
Pl. 2, figs. 57–61.
Linear, 37–70 μ long, 4–5 μ wide, apices capitate; costae delicate, about 7 in 10 μ; striations fine, about 17 in 10 μ.

Devils Lake, N. Dak.; Stockton, Cal.

3. **Odontidium hiemale** (Ag.) Kütz. *Bacill., p. 41, pl. 17, fig. 4. 1844.*
Fragilaria hyemalis Ag. *Syst. Alg., p. 7. 1824.*
Pl. 2, figs. 62–65.
Cells lanceolate or elliptical, sometimes with apices produced (fig. 63), 15–50 μ long, ribs 2.5–3 in 10 μ, striations 18–20 in 10 μ. Var. *mesodon, O. mesodon* Kütz., is a form more nearly like the specimens found.

Bellevue.
Fossil: Cherry Co.
Chippewa Falls, Wis.

4. **Odontidium anceps** (Ehr.) Elmore.
Diatoma anceps (Ehr.) Grun.
Pl. 22, fig. 815.
Linear with apices rostrate or capitate, 20–50 μ long, 5–7 μ wide; striations about 21 in 10 μ; 6–14 heavy costae which are more or less oblique; cells rectangular in girdle view.

In lake, Estes Park, Colo.

13. Fragilaria

Fragilaria Lyngb. *Hydrophyt. Dan., p. 182. 1819.*

Etym., Lat. *fragilis*, fragile, the filaments resembling filamentous algae, but easily broken apart.

Cells united in mostly ribbon-like, rarely zigzag chains, cells symmetrical in all three planes; girdle view rectangular, mostly narrowly linear; valves linear-lanceolate or fusiform, flat, transversely striate or with transverse rib-like beaded markings, but no true ribs; pseudoraphe present; no nodules.

A. Pseudoraphe narrow, scarcely visible. 1. *F. virescens.*
AA. Pseudoraphe distinct.
b. Striations of distinct beads. 2. *F. capucina.*
bb. Striations heavy with beads more or less confluent.
c. Small, broadly oval or cruciform.
d. Varying from cruciform to constricted in the middle. 3. *F. construens.*
dd. Regularly oval. 4. *F. mutabilis.*
cc. Cruciform with heavy costae. 5. *F. harrisonii.*

1. **Fragilaria virescens** Ralfs in *Ann. and Mag. Nat. Hist., XII. pl. 2, fig. 6. 1843.*

Fragilaria virescens Kütz. *Bacill., p. 46, pl. 16, fig. 4. 1844.*

Pl. 2, figs. 66–67.

Cells linear or linear-elliptic with apices attenuate and often rostrate-obtuse, 20–60 μ long; striations distinctly punctate, 15–18 in 10 μ, extending nearly across the valve, scarcely leaving a rachis.

Hackberry Lake.
Fossil: Cherry Co.

2. **Fragilaria capucina** Desmaz. *Crypt. de Franc., Ed. I, No. 453. 1825.*

Pl. 2, figs. 68–72.

Valves linear, narrow with apices more or less rostrate, 23–60 μ long; in the form called var. *mesolepta*, fig. 72, constricted in the middle; margin of the valve with very distinct beads which extend across the valve as delicate striations, leaving a narrow pseudoraphe, 14–15 in 10 μ; cells united in long band-like filaments.

In still or slowly running water, especially common in stock tanks, also fossil: Andrews, Bellevue, Cody Lake, Crawford, Culbertson, Dismal

River, Dunning, Durly Lake, Grand Island, Hackberry Lake, Hastings, Ithaca, Johnson, Lakeside, Long Pine, Milford, North Platte, Pelican Lake, Plattsmouth, Ruby, Seneca, St. Michael, Stromsburg, Talmage, Thedford, Valentine, West Point, Whitman.

Fossil: Cherry County, Loup City, Williams's Canyon.

Cutmeat, Dallas, Kadoka, Rapid City, Turtle River, S. Dak.; Devils Lake, N. Dak.; Stockton, Cal.; Put-in Bay, Ohio.

3. **Fragilaria construens** (Ehr.) Grun. in *Wien. Verh., p. 371. 1862.*

Staurosira construens Ehr. *Abh., p. 424. 1841.*

Pl. 2, figs. 73–84; pl. 22, fig. 816.

Very variable, from oval to cruciform, or sometimes contracted in the middle, 11–16 μ long; rachis lanceolate, striations 10–18 in 10 μ; cells united in short filaments. Var. *venter* and var. *binodis* have been described, but they are probably mere forms.

Very common in creeks, rivers, ponds, etc., especially where the water is quiet and conditions for algae are good, also fossil: Andrews, Burge, Clear Lake, Crawford, Culbertson, Dewey Lake, Dismal River, Dunning, Gordon Creek, Grand Island, Halsey, Ithaca, Long Pine, Melia, New Helena, Niobrara River, Norfolk, North Platte, Oakdale, O'Neill, Red Cloud, Seneca, Thedford, Valentine, West Point.

Fossil: Agate, Cherry County, Hay Springs, Greeley County, Loup City, Merriman, Mullen, Spalding, Thedford, Wheeler County, Williams's Canyon.

Turtle River and Rosebud, S. Dak.

4. **Fragilaria mutabilis** (W. Sm.) Grun. *Oest. Diat., p. 369. 1882.*

Odontidium mutabile W. Sm. *Brit. Diat., II, p. 17, pl. 34, fig. 290. 1856.*

Pl. 2, fig. 85; pl. 22, fig. 817.

Cells from almost circular to oval, elliptical, or linear-acuminate, 5–25 μ long; striations distinct, not resolvable into beads, 7–10 in 10 μ.

St. Paul, Seneca, Snake Creek.

Fossil: Cherry County, Mullen, Wheeler County.

Blackpipe, S. Dak.

5. **Fragilaria harrisonii** (W. Sm.) Grun. *Oest. Diat., p. 369. 1882.*

Odontidium harrisonii W. Sm. *Brit. Diat., II, p. 18. 1856.*

Pl. 2, fig. 86.

Cells cruciform, 20–50 μ long; striations very distinct, shortened, leaving a broad rachis, 4–5 in 10 μ.

Burge, Long Pine, North Platte, St. Paul, Valentine.
Fossil: Agate.
Blackpipe, Rapid City, S. Dak.

14. Synedra

Synedra Ehr. in *Ber., p. 40. 1830.*

Etym., Gr. συνέδριον, sitting together, the cells being united in clusters.

Desmogonium Ehr.; *Echinella* Breb.; *Exilaria* Grev.; *Tabularia* Kütz.

Cells usually attached, single or in fan-shaped clusters, sessile or stipitate; very much elongated, more or less lanceolate-linear, sometimes more or less wrinkled; usually with a pseudoraphe, sometimes with false central and polar nodules; chromatophores, two plates with lobed margins.

A. Striations extending throughout nearly the breadth of the valve.
  b. Valves with a pseudonodule. 1. *S. pulchella.*
  bb. Without a pseudonodule.
    c. With median hyaline space (hyaline space sometimes lacking).
      d. Narrowly linear-lanceolate.
        e. Striations distinct, about 13 in 10 μ. 2. *S. tenuissima.*
        ee. Striations fine, 16–18 in 10 μ. 3. *S. radians.*
      dd. Linear-oblong or lanceolate. 4. *S. familiaris.*
      ddd. Narrowly linear. 5. *S. ulna.*
    cc. Without median hyaline space.
      d. Very large with apices triangular-capitate. 6. *S. capitata.*
      dd. Not triangular-capitate.
        e. Cells large. 5. *S. ulna.*
        ee. Cells small.
          f. Striations and pseudoraphe distinct. 7. *S. amphicephala.*
          ff. Striations fine; pseudoraphe indistinct. 8. *S. famelica.*
AA. Striations marginal. 9. *S. tabulata.*

1. **Synedra pulchella** Kütz. *Bacill., p. 68, pl. 29, fig. 87. 1844.*
Pl. 3, figs. 91–96.

Narrowly lanceolate with apices slightly rostrate-capitate, 30–60 μ long; pseudonodule distinct, often reaching to the margins; pseudoraphe narrow, terminated by small nodules; striations 12–14 in 10 μ, distinctly punctate; girdle face linear, attenuated at the ends.

In ponds, lakes, rivers, etc.: Cedar Creek, Culbertson, Dismal River, Grand Island, North Platte, Pelican Lake, Red Cloud, Seneca, Stromsburg.
Fossil: Loup City.
Devils Lake and fresh water near Devils Lake, N. Dak.; Stockton, Cal.

2. **Synedra tenuissima** Kütz. *Bacill., p. 64, pl. 14, fig. 6. 1844.*
Frustulia tenuissima Kütz. *Syn. Diat., p. 24, pl. 2, fig. 22. 1834.*
Synedra acus Kütz. *Bacill., p. 68, pl. 30, fig. 50. 1844.*
Pl. 3, figs. 97–104.

Narrowly lanceolate with apices slightly rostrate-capitate, sometimes constricted in the middle and sometimes swollen, 45–230 μ long; pseudoraphe narrow, striations distinct, 12–13 in 10 μ, usually lacking in the center, leaving a rectangular clear space. Very variable, some forms like forms of *S. ulna,* from which it can be distinguished only by the finer striations. Some forms are described as var. *delicatissima,* fig. 97, and var. *angustissima,* figs. 98–99.

With *Cladophora, Oscillatoria, Spirogyra,* and other algae in tanks, creeks, etc.: Cherry County, Crawford, Dewey Lake, Fremont, Hemingford, Holt County, South Bend, Talmage, Tecumseh, Valentine, Weeping Water.
Fossil: Greeley County, Spalding.
Court Lake, Devils Lake, N. Dak.; Cutmeat, S. Dak.; Stockton, Cal.; Put-in Bay, Ohio.

3. **Synedra radians** Kütz. *Bacill., p. 64, pl. 14, fig. 7. 1844.*
Pl. 3, figs. 105–114.

Very narrowly linear-lanceolate, tapering toward the ends, sometimes capitate, 30–100 μ long; striations delicate, leaving a very narrow pseudoraphe, 16–18 in 10 μ, usually lacking in the middle of the valve, leaving a clear space. Deformed specimens have

been found (figs. 110–114) in tanks at Central City and Stromsburg, Nebraska, and in Put-in Bay, Ohio.

In tanks, ditches, ponds, creeks, and rivers: Cairo, Central City, Crawford, Halsey, Meadow, North Platte, Red Cloud, Scottsbluff, Seneca, Talmage, Tekamah, Thedford.

Fossil: Mullen.

Cheyenne, Wyo.; Chippewa Falls, Wis.; Weta, S. Dak.; Sully's Hill, N. Dak.; Fresno, Stockton, Cal.; Put-in Bay, Ohio.

4. **Synedra familiaris** Kütz. *Bacill., p. 68, pl. 15, fig. 12. 1844.*
Pl. 3, fig. 115.

Linear-oblong or lanceolate, 37–80 μ long, apices attenuate-rostrate or capitate; striations 13–17 in 10 μ, lacking in the middle, leaving a clear space; center contracted or sometimes swollen; pseudoraphe narrow; cells sometimes cohering in short bands.

In tanks, rivers, etc.: Clear Lake, Dewey Lake, Dismal River, Halsey, Long Pine, Melia, O'Neill, Talmage, Tekamah, Thedford.

Fossil: Greeley County.

5. **Synedra ulna** (Nitz.) Ehr. *Inf., p. 211. 1838.*
Bacillaria ulna Nitz. *Beitr., p. 99. 1817.*
Pl. 3, figs. 116–130; pl. 4, figs. 131–139.

Narrowly linear or somewhat lanceolate with ends more or less elongated-rostrate, sometimes capitate, 50–350 μ long; striations distinct, 9–10 in 10 μ, leaving a narrow pseudoraphe, usually lacking in the middle, leaving a rectangular clear space. Very variable and presenting many forms that have been described as species or varieties; among these are *danica,* figs. 118, 123, 132, 133, and *splendens,* figs. 116, 117, 131. It is impossible to separate these forms from one another. Some of them can be distinguished from *S. tenuissima* only by their coarser striations.

Common in tanks, creeks, ponds, etc., with various algae: Andrews, Anselmo, Arago, Ashland, Battle Creek, Bellevue, Benkleman, Brock, Broken Bow, Burge, Cedar Creek, Central City, Clear Lake, Cody Lake, Columbus, Crawford, Crete, Dewey Lake, Dismal River, Dunning, Emerald, Emmett, Ewing, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey, Holt County, Hyannis, Lakeside, Lincoln, Lodi, Long Pine, Meadow, Melia, Milford, New Helena, Newport, Norfolk, North Platte, Northport, Oakdale, O'Neill, Orleans, Pelican Lake, Phalaris Lake, Pleasant Dale, Red Cloud, Ruby, Rupert, St. Michael, St. Paul, Scottsbluff,

Seneca, Seward, Snake River, South Bend, Stromsburg, Talmage, Tekamah, Thedford, Valentine, Wann, Weeping Water, West Point, Whitman, Willow Lake, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Williams's Canyon.

Belvidere, Blackpipe, Cutmeat, Kadoka, Little White River, Norris, Rapid City, Redleaf, Rosebud, Weta, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Fresno, Stockton, Cal.; Blackhand, Granville, New Concord, Put-in Bay, Rio Grande, Ohio.

6. **Synedra capitata** Ehr. in *Poggendorff's Annalen Phys., pl. 3, fig. 3. 1836.*

Pl. 4, fig. 140.

Linear, 200–500 μ long, apices triangular-capitate, somewhat attenuated at the tip; pseudoraphe narrow; striations distinct, about 8 in 10 μ. This species seems to be somewhat constant in form, but variable in size. The form called *S. ulna* var. *longissima*, figs. 138–139, seems to belong to this species, as all gradations are found between the two.

In springs, etc., with luxuriantly-growing algae and other diatoms: Anselmo, Bellevue, Burge, Gordon Creek, Norfolk, North Platte, Oakdale, St. Paul, Scottsbluff, Seneca, Thedford, Valentine, Woodlake.

Fossil: Agate, Greeley County, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Wheeler County.

7. **Synedra amphicephala** Kütz. *Bacill., p. 64, pl. 3, fig. 12. 1844.*

Pl. 4, figs. 141–142.

Very narrowly lanceolate with ends more or less rostrate-capitate, 40–60 μ long; striations very distinct, 11–12 in 10 μ, leaving a narrow but distinct pseudoraphe.

Atkinson.

Fossil: Agate, Cherry Co.

8. **Synedra famelica** Kütz. *Bacill., p. 64, pl. 14, fig. 8. 1844.*

Pl. 4, fig. 143.

Broadly to narrowly lanceolate; apices rostrate-capitate, 22–30 μ long; striations 20–21 in 10 μ, leaving a very narrow or indistinct pseudoraphe.

Pool by railroad, Devils Lake, N. Dak.

9. **Synedra tabulata** (Ag.) Kütz. *Bacill., p. 68, pl. 15, fig. 10. 1844.*

Diatoma tabulatum Ag. *Consp. Diat., p. 50. 1830.*

Synedra affinis var. *tabulata* V. H. *Syn., p. 153. 1885.*

Pl. 4, figs. 144–146.

Lanceolate with ends sometimes slightly rostrate-capitate, 90–175 μ long; striations short, leaving a very wide pseudoraphe, 10–13 in 10 μ; frustules arranged radially.

Common in brackish water; Arbor, in salt marsh; Lincoln, in Salt Creek; Scottsbluff, Thedford.

Devils Lake and fresh water near Devils Lake, N. Dak.

15. Asterionella

Asterionella Hassall in *Micr. Exam., p. 10. 1856.*

Etym., diminutive of Greek ἀστήρ, star, referring to the radial arrangement of the cells.

Cells elongated, linear; apices unequally capitate; girdle face linear with apices unequally inflated; cells radially arranged.

Asterionella gracillima (Hantzsch) Heiberg. *Consp., p. 68, pl. 6, fig. 19. 1863.*

Diatoma gracillimum Hantzsch in *Rabenh. Alg., No. 1104.*

Pl. 2, figs. 88–90.

Valves very narrow, linear, tapering toward the rounded capitate ends, the basal end larger than the other, 42–100 μ long, about 2 μ wide in the middle; striations 15–17 in 10 μ, interrupted by a very narrow rachis.

In San Joaquin River, Stockton, Cal.

16. Eunotia

Eunotia Ehr. in *Ber. Berl. Akad., p. 45. 1837.*

Etym., Gr. εὖ, well, and νῶτος, back, in reference to the strongly curved dorsal margin.

Cells free, or united in filaments, or attached; in girdle view rectangular-oblong, in valve view arcuate, the convex margin often undulate; valves with transverse striations, no ribs, pseudoraphe not evident; polar nodules present, central nodule wanting;

chromatophores small, plate-like; auxospore one from two mother cells.

A. Cells united in filaments.
  b. Rostrate-capitate. 1. *E. arcus.*
  bb. Scarcely capitate. 2. *E. major.*
AA. Cells not united in filaments.
  b. Slightly arcuate.
    c. With slight median enlargement. 3. *E. formica.*
    cc. With no median enlargement. 4. *E. lunaris.*
  bb. More or less wrinkled.
    c. With two dorsal swellings. 5. *E. diodon.*
    cc. With several dorsal swellings. 6. *E. robusta*
    ccc. With both dorsal and ventral swellings. 7. *E. eruca.*

1. **Eunotia arcus** Ehr. *Inf., p. 191. 1838.*

Pl. 5, fig. 149; pl. 22, figs. 819–820.

Curved, 30–90 μ long, ends capitate, often only slightly so, ventral margin straight or slightly concave, dorsal margin convex and sometimes undulate, constricted on the dorsal margin near the ends; striations punctate, 12–15 in 10 μ.

Cody Lake, Columbus, Culbertson, Scottsbluff, Thedford.
Fossil: Greeley County, Loup City, Mullen.

2. **Eunotia major** (W. Sm.) Rabenh. *Fl. Eu. Alg., I, p. 72. 1864.*

Himantidium majus W. Sm. *Brit. Diat., II, p. 14, pl. 33, fig. 286. 1856.*

Pl. 5, figs. 150–152.

Arcuate with parallel margins, 62–190 μ long, ends obtusely rounded, sometimes capitate; striations finely punctate, 9–12 in 10 μ.

Clear Lake, Dismal River, Dunning, Hackberry Lake, Long Pine, Thedford, Whitman, Woodlake.
Fossil: Agate, Cherry County, Merriman, Mullen.

3. **Eunotia formica** Ehr. *Verb., p. 126. 1843.*

Pl. 5, figs. 153–155.

Arcuate, 70–162 μ long, 8–14 μ wide, width practically the same throughout the entire length; apices rounded or triangular-acute; ventral side gibbous in the middle, dorsal side slightly inflated,

straight or indented in the middle; terminal nodules near the ventral margin; striations distinct, 7–9 in 10 μ. Fig. 153 is the form called var. *elongata* Grun.

With other algae: Dismal River, St. Paul.
Fossil: Greeley County, Mullen.
Little White River, S. Dak.

4. **Eunotia lunaris** (Ehr.) Grun. in *V. H. Syn., p. 144, pl. 35, figs. 2–6. 1885.*
Synedra lunaris Ehr. in *Abh. Berl. Akad., p. 87. 1831.*
Pl. 5, figs. 156–162; pl. 22, fig. 818.

Arcuate, 35–143 μ long, 4–8 μ wide; width uniform throughout the entire length except at the ends, which are usually slightly constricted on the dorsal margin, making the ends rostrate or capitate; terminal nodules round, distinct, on the ventral side; striations granular, 12–15 in 10 μ. Sometimes the cells have a single or a double curve, making the form called var. *bilunaris* (figs. 160–162).

Common in creeks, ponds, lakes, tanks, etc.: Anselmo, Atkinson, Auburn, Bellevue, Big Alkali Lake, Broken Bow, Brownlee, Cedar Creek, Central City, Clear Lake, Culbertson, Dewey Lake, Dismal River, Dunning, Emerald, Fremont, Grand Island, Hackberry Lake, Halsey, Hyannis, Lincoln, Lodi, Long Pine, New Helena, O'Neill, Osage, Pelican Lake, Peru, St. Michael, Seneca, Talmage, Tekamah, Thedford, Valentine, Wann, West Point, Whitman, Woodlake.
Fossil: Agate, Cherry County, Merriman, Mullen, Spalding, Thedford, Valentine, Williams's Canyon.
Cheyenne, Wyo.; Cutmeat, Rapid City, S. Dak.; Sully's Hill, N. Dak.; Fresno, Stockton, Cal.

5. **Eunotia diodon** Ehr. *Inf., p. 192. 1838.*
Pl. 5, fig. 163.

Slightly arcuate, 34–50 μ long, 7–8 μ wide; ventral margin slightly concave, dorsal margin convex with two inflations; apices sometimes capitate, not bent backward; terminal nodules distinct, near the ventral side; striations distinct, 8–10 in 10 μ.

In ponds, rivers, lakes, etc.: Clear Lake, Dismal River, Hackberry Lake, Halsey, Seneca.
Fossil: Agate, Cherry County, Mullen, Valentine.

6. **Eunotia robusta** Ralfs in *Pritch. Inf., p. 763.*

Pl. 5, fig. 164.

Arcuate with nearly parallel margins; dorsal margin with several swellings, ventral margin usually without swellings; 48–90 μ long, 9–10 μ wide; ends rounded; striations perpendicular to the dorsal margin, 9–10 in 10 μ.

In San Joaquin River, Stockton, Cal.

7. **Eunotia eruca** Ehr. *1844.*

Pl. 5, figs. 165–167.

Valves arcuate, 48–88 μ long, 8–12 μ wide; apices produced; both dorsal and ventral margins undulate; striations perpendicular to the dorsal margin, 8–10 in 10 μ.

In San Joaquin River, Stockton, Cal.

17. Ceratoneis

Ceratoneis Ehr. 1840, Emend. Grun. *Diat. Insl. Banka, p. 7, 1865.*

Etym., Gr. κέρας, horn.

Cells single, free; valves lunate; pseudoraphe nearer to the ventral than to the dorsal side, the ventral side with a swelling opposite the central nodule; terminal nodules more distinct than the central; cells rectangular in girdle view.

Ceratoneis arcus (Ehr.) Kütz. *Bacill., p. 104, pl. 6, fig. 10. 1844.*

Navicula arcus Ehr. *Inf., p. 182, pl. 21, fig. 10. 1838.*

Pl. 5, figs. 168–169; pl. 22, figs. 821–822.

Valves arcuate, 30–109 μ long, 3–4 μ wide, slightly lanceolate with a median inflation on the ventral side; apices more or less capitate, bent slightly toward the dorsal side; striations finely punctate, perpendicular to the margins, 13–15 in 10 μ.

In San Joaquin River, Stockton, Cal.

Family 6. NAVICULACEAE

Cells free-swimming, stipitate, enclosed in gelatinous tubes, or occasionally adhering in filaments. Rachis containing a median elongated slit (raphe). Valves with transverse striations which are interrupted by the rachis.

18. Mastigloia

Mastigloia Thwaites in *W. Sm. Brit. Diat., II, p. 64. 1856.*

Etym., Gr. μαστός, breast, and γλοιός, gelatinous, from the form of the mass in which it grows.

Cells naviculoid with transverse septa between the valve and the girdle; septa on the margins forming regularly arranged compartments, leaving an oval or linear space in the middle of the valve. In girdle view the compartments appear as a row of coarse dots. Valves symmetrical, ends attenuate, capitate, or cuneate; striations fine, granular. Chromatophores double, lying next to the valves, deeply constricted in the middle or consisting of four plates which lie either next to the valves or the girdle, but are not united at the ends.

A. Marginal cells arranged in a curved row.	1. *M. smithii.*
AA. Marginal cells arranged in a straight row.	
b. Striations consisting of fine dots.	2. *M. elliptica.*
bb. Striations consisting of coarse dots.	3. *M. grevillei.*

1. **Mastigloia smithii** Thwaites in *W. Sm. Brit. Diat., II, p. 65, pl. 54, fig. 341. 1856.*

Pl. 5, fig. 170.

Lanceolate, more or less rostrate, or sometimes rostrate-capitate, 27–53 μ long, 10–15 μ wide; striations radiate, consisting of dots arranged in longitudinal rows, 12–18 in 10 μ, longitudinal rows closer; shortened, leaving a small round or rectangular space in the center; marginal cells 5–8 in 10 μ, arranged in a curved row, not extending to the ends of the cell.

In fresh water, Court Lake near Devils Lake, N. Dak.

2. **Mastigloia elliptica** (Ag.) Schönf. *Süssw. Fl., p. 63. 1913.*
Frustulia elliptica Ag. in *Kütz. Syn. Diat., p. 10. 1833.*
Mastigloia dansei Thw. in *W. Sm. Brit. Diat., p. 64, pl. 62, fig. 388. 1856.*

Pl. 5, figs. 171–175.

Elliptical or linear-elliptical, 22–51 μ long, 10–18 μ wide; ends rounded, slightly constricted or cuneate; striations granular, radiate, 15–20 in 10 μ, slightly curved, the middle ones alternately longer and shorter; marginal rows of cells about 8 in 10 μ, not

extending to the ends of the valves. The form described as var. *dansei* Thw., *Schönf. l.c.*, is more nearly represented by figs. 174–175, being more linear with cuneate ends.

Lakeside, North Platte, Scottsbluff.
Devils Lake and fresh water near Devils Lake, N. Dak.

3. **Mastigloia grevillei** W. Sm. *Brit. Diat., II, p. 65, pl. 62, fig. 389. 1856.*

Pl. 5, figs. 176–177.

Linear-elliptical, slightly tapering at the ends, 35–60 μ long, 10–12 μ wide; striations coarsely granular, radiating, 10–15 in 10 μ, shortened opposite the central nodule, leaving a rounded hyaline space; marginal rows of cells about 8 in 10 μ.

In pond with *Cladophora*, Scottsbluff.

19. Navicula

Navicula Bory. *Dict. Class., XI, p. 472. 1826.*

Etym., Lat. diminutive of *navis*, boat, from the boat-shaped valves.

Cells single, free or enclosed in gelatinous tubes, or rarely cohering in chains; elliptical to linear-lanceolate in valve view, rectangular and straight in girdle view; with or without interzones, interzonal septa not marginally chambered; valves bilaterally symmetrical with a straight or slightly curved raphe, no keel; with round central and polar nodules; surface transversely punctate-striate or ribbed. Auxospore formation: two mother cells lying parallel to each other surround themselves with a gelatinous envelope, cast off the old valves, and the contents of the two unite, forming two auxospores which are surrounded by a siliceous sheath (perizonium).

A. With costae, *i.e.*, heavy ribs.
b. Costae not composed of rows of dots. 1. *Pinnulariae*, page 63.
bb. Striations heavy appearing like costae, but composed of rows of dots. 2. *Radiosae*, page 71.
AA. Striations consisting of rows of dots.
b. Valves with striations interrupted by two sulci near the raphe. 3. *Lyratae*, page 81.
bb. Valves more or less lanceolate, elliptic, or linear-lanceolate, without a sulcus.

c. Valves having the appearance of a stauros, either by the absence of striations or by the space between them.
4. *Stauroneideae,* page 81.
cc. Valves without any appearance of a stauros.
d. Striations with dots not forming longitudinal lines.
e. Striations shortened leaving a wide hyaline space along the raphe. 5. *Palpebrales,* page 83.
ee. Striations extending nearly to the raphe.
6. *Perstriatae,* page 83.
dd. Striations with dots forming straight longitudinal lines.
7. *Crassinerves,* page 83.
ddd. Striations with dots forming zigzag horizontal lines.
e. Striations interrupted by a sulcus.
8. *Sculptae,* page 86.
ee. Striations not interrupted by a sulcus.
9. *Serianteae,* page 87.
bbb. Valves with one or more marginal or submarginal sulci.
c. Lanceolate, large, striations fine, radiate, leaving a large hyaline space around the central nodule.
10. *Formosae,* page 88.
cc. Elongated, more or less triundulate; sulcus marginal, often inconspicuous; raphe surrounded by a narrow, lanceolate hyaline space; striations radiate.
11. *Limosae,* page 88.
ccc. Striations nearly perpendicular to the raphe, usually slightly oblique; sulcus broad, distinct. 12. *Affines,* page 90.
bbbb. Linear, no sulcus. 13. *Bacillieae,* page 92.
bbbbb. Very small, structure indistinct. 14. *Minutissimae,* page 93.

I. Pinnulariae

A. Majores. Cells large, costae broad and heavy.
b. Costae shortened leaving a broad hyaline space along the raphe.
1. *N. nobilis.*
bb. Costae extending more nearly to the raphe.
c. Inflated in the middle. 2. *N. major.*
cc. Not inflated in the middle. 3. *N. viridis.*
AA. Minores. Cells of medium or small size, costae not so coarse.
b. Neither constricted in the middle nor undulate.
c. Costae heavy and distant.
d. Linear-elliptical or elliptical, striations not extending to the raphe. 4. *N. lata.*
dd. Linear, striations reaching nearly to the raphe.
e. Striations shortened in the middle.
5. *N. borealis.*

ee. Striations lacking in the middle.
6. *N. intermedia.*

cc. Costae finer.
d. Not inflated in the middle or only slightly so.
e. Apices not rostrate-capitate.
f. Apices neither inflated nor attenuate.
7. *N. stauroneiformis.*
ff. Apices somewhat attenuate.
g. Costae delicate. 8. *N. brebissonii.*
gg. Costae heavier. 9. *N. rangoonensis.*
fff. Apices inflated.
g. Slightly or not at all inflated in the middle.
10. *N. parva.*
gg. More inflated in the middle.
11. *N. decurrens.*
ee. Apices rostrate-capitate.
f. Costae distant. 12. *N. subcapitata.*
ff. Costae closer. 13. *N. appendiculata.*
dd. Inflated in the middle. 14. *N. braunii.*
bb. Constricted in the middle or undulate.
c. Apices strongly rostrate-capitate.
d. Swollen in the middle. 15. *N. mesolepta.*
dd. Constricted in the middle. 16. *N. thermes.*
cc. Apices slightly rostrate.
d. Striations strongly radiate. 17. *N. legumen.*
dd. Striations slightly radiate. 18. *N. nodosa.*
ccc. Apices rounded or slightly constricted.
19. *N. acrosphaeria.*

1. **Navicula nobilis** (Ehr.) Kütz. *Bacill., p. 98, pl. 4, fig. 24. 1844.*
Pinnularia nobilis Ehr. *Abh., p. 20. 1840.*
Pl. 6, figs. 178–182.

Linear-elliptic, slightly swollen in the middle and at the ends, 127–400 μ long, 16–50 μ wide; costae heavy, 4–8 in 10 μ, radiating in the middle, then parallel, and slightly converging at the ends, shortened, leaving a hyaline area along the raphe about one-third the width of the valve.

With luxuriantly-growing algae in rivers, etc.: Clear Lake, Crete. Fossil: Cherry County, Mullen.

2. **Navicula major** Kütz. *Bacill., p. 97, pl. 4, fig. 19. 1844.*
Pinnularia major Rabenh. *Süssw. Diat., p. 42, pl. 6, fig. 5. 1853.*

Pl. 6, fig. 184.

Linear-elliptic, more or less swollen in the middle and at the ends, 161–300 μ long, 23–30 μ wide; costae radiating at the center and converging at the ends, coarse, 5–7 in 10 μ, extending more nearly to the raphe than in *N. nobilis.*

With luxuriantly-growing algae in rivers, lakes, ponds, etc.: Aspinwall, Clear Lake, Crawford, Dewey Lake, Dismal River, Fairbury, Grand Island, Hackberry Lake, Halsey, Lakeside, Long Pine, Louisville, New Helena, Red Cloud, Rupert, St. Michael, Seneca, Thedford, Wahoo.

Fossil: Agate, Cherry County, Hay Springs, Loup City, Merriman, Spalding, Thedford, Valentine.

Rosebud, S. Dak.; Stockton, Cal.

3. **Navicula viridis** (Nitz.) Kütz. *Bacill., p. 97, pl. 4, fig. 18; pl. 30, fig. 12. 1844.*

Bacillaria viridis Nitz. *Beitr., pl. 6, figs. 1–3. 1817.*

Pl. 6, figs. 185–191.

Linear-elliptic, often slightly oval, without inflations; ends rounded, 20–200 μ long, 11–32 μ wide; costae heavy, 5–8 in 10 μ, extending nearly to the raphe, radiating in the center, converging at the ends.

In ponds, creeks, rivers, ditches, tanks, etc.: Andrews, Arago, Ashland, Aspinwall, Auburn, Broken Bow, Burge, Brownlee, Cairo, Callaway Central City, Clear Lake, Columbus, Crawford, Culbertson, Dewey Lake, Dismal River, Dunbar, Dunning, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Holt County, Lakeside, Lincoln, Lodi, Long Pine, Louisville, Meadow, New Helena, North Platte, O'Neill, Orella, Pelican Lake, Rupert, St. Michael, St. Paul, Seneca, Snake River, Stanton, Stromsburg, Tekamah, Thedford, Trenton, Valentine, Wahoo, Wann, Weeping Water, West Point.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Thedford, Valentine.

Blackpipe, Little White River, Rapid City, Rosebud, Turtle River, S. Dak.; Cheyenne, Wyo.; Court Lake and fresh water near Devils Lake, N. Dak.; Stockton, Cal.; Ft. Collins, Colo.

4. **Navicula lata** (Breb.) Kütz. *Bacill., p. 92, pl. 3, fig. 51. 1844.*

Frustulia lata Breb. *Consp. Diat., p. 18. 1838.*

Pl. 7, figs. 192–193.

Linear-elliptical or elliptical, often inflated in the middle, 32–110 μ long, 14–40 μ wide; apices obtuse, broadly rounded; costae

very heavy, 4–6 in 10 μ, slightly radiate in the center and converging at the ends, not reaching to the raphe, those around the central nodule shortened, leaving a round hyaline space.

With luxuriantly-growing *Cladophora* in creeks and ponds: Anselmo Seneca.

Blackpipe, S. Dak.

5. **Navicula borealis** (Ehr.) Kütz. *Bacill., p. 96, pl. 28, figs. 68–72. 1844.*

Pinnularia borealis Ehr. *Verb., pl. I, II, fig. 6. 1843.*

Pl. 7, figs. 194–199.

Linear-elliptic, sometimes slightly attenuate, 30–68 μ long; apices rounded or truncate; costae slightly radiate in the middle, converging at the ends, very heavy, 3–6 in 10 μ, reaching almost to the raphe, except those around the central nodule, which are shorter, leaving a round hyaline space. Differs from *N. lata* mainly in its more linear outline.

In ponds, rivers, creeks, pools, ditches, etc.: Ainsworth, Columbus, Crawford, Dismal River, Dunning, Fremont, Grand Island, Long Pine, Milford, Norfolk, North Platte, O'Neill, St. Paul, Stanton, Trenton.

Fossil: Valentine.

Belvidere, Conata, Little White River, Norris, Rapid City, Rosebud, Scenic, S. Dak.; Stockton, Cal.

6. **Navicula intermedia** Lagerst. *Spetz. Diat., p. 23, pl. 1, fig. 3. 1873.*

Pl. 7, figs. 200–205.

Linear-elliptic with rounded ends, 18–42 μ long, 5–8 μ wide; striations heavy, radiating, 9–10 in 10 μ, lacking in the center, leaving a transverse hyaline space.

Fossil: Agate.

Belvidere, S. Dak.

7. **Navicula stauroneiformis** Elmore.

Pinnularia aestuarii (Breb.) Cl. *Nav. Diat., II, p. 93, pl. 1, fig. 16. 1895.*

Navicula aestuarii Breb. in *Kütz. Spec. Alg., p. 890, 1849,* is *Gyrosigma.*

Pl. 7, figs. 206–207.

Linear with parallel margins and rounded ends, 100–120 μ long, about 16 μ wide; raphe flexuose; striations parallel, shortened, leaving a moderately wide hyaline space along the raphe, entirely lacking in the middle, forming a pseudostauros, 7–10 in 10 μ. The specimens shown in figures 206 and 207 are 82 μ and 37 μ long, respectively, but appear to belong to this species.

Clear Lake.

8. **Navicula brebissonii** Kütz. *Bacill., p. 93, pl. 3, fig. 49; pl. 30, fig. 39. 1844.*

Pl. 7, figs. 208–229.

Linear-elliptic, oblong, or elliptic, sometimes constricted in the middle, 14–68 μ long, 6–13 μ wide; apices varying from obtuse to slightly rostrate-capitate; costae radiating in the center, but toward the ends suddenly becoming convergent, either shortened or entirely lacking around the central nodule, 9–12 in 10 μ; the empty valves usually of a brownish color. Very variable. The following forms have been described: var. *angustata* Grun., very narrow, ends attenuate; var. *linearis* O. Müller, margins straight, ends broad, round; var. *diminuta* V. H., narrower than the typical form, ends always narrowed; var. *notata* Heibrand and Peragallo, a small form with cuneate ends; var. *ornata* O. Müller, a form with dots more or less regularly arranged in the hyaline area, especially along the raphe; var. *subproducta* V. H., broader and shorter with apices slightly rostrate.

In creeks, ponds, pools, rivers, etc.: Andrews, Anselmo, Arago, Ashland, Auburn, Benkleman, Brock, Broken Bow, Brownlee Callaway, Central City, Chadron, Clear Lake, Cook, Crawford, Culbertson, Dismal River, Fairbury, Grand Island, Hackberry Lake, Halsey, Johnson, Lodi, Louisville, Mason City, Milford, New Helena, North Platte, Northport, O'Neill, Orella, Peru, Roca, St. Paul, Scottsbluff, Seneca, Seward, Sheridan County, Snake River, Stanton, Stromsburg, Talmage, Trenton, Valentine, Weeping Water, West Point, Whitman.

Fossil: Agate, Cherry County, Hay Springs, Merriman, Thedford.

Belvidere, Blackpipe, Cutmeat, Little White River, Rapid City, Rosebud, Scenic, Turtle River, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Rodney, Ohio.

9. **Navicula rangoonensis** (Grun.) Elmore.

Pinnularia rangoonensis Grun. in Ms.

Pl. 22, figs. 823–824.

Valves linear with rounded ends, 64–100 μ long, 10–14 μ wide; striations radiate in the middle and converging at the ends, gradually shortened toward the middle, where they are entirely lacking, 9–10 in 10 μ.

In pool, Long Pine.

10. **Navicula parva** (Ehr.) Elmore.

Stauroptera parva Ehr. *Verb., p. 135, pl. 3, fig. 19. 1843.*

Navicula stauroptera Grun. in *Wien. Verh., p. 516, pl. 2, fig. 18. 1860.*

Pl. 7, figs. 231–246.

Linear or oblong, sometimes elliptical, often slightly swollen in the middle, 36–100 μ long, 7–13 μ wide; apices rounded or slightly swollen; costae radiate in the middle and converging at the ends, 8–12 in 10 μ, shortened, leaving a broad hyaline space along the raphe, becoming shorter toward the center, where they are usually entirely lacking.

Common where conditions for algae are good, in creeks, rivers, lakes, etc.: Alma, Anselmo, Arago, Broken Bow, Brownlee, Clear Lake, Crawford, Crete, Culbertson, Dismal River, Dunning, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Julian, Lincoln, Lodi, Long Pine, Louisville, North Platte, O'Neill, Orleans, Red Cloud, Seneca, Stanton, Talmage, Thedford, Valentine, Weeping Water, West Point.

Fossil: Agate, Loup City, Mullen, Thedford.

Belvidere, Blackpipe, Little White River, Rosebud, S. Dak.; Devils Lake, N. Dak.; Stockton, Cal.

11. **Navicula decurrens** (Ehr.) Kütz. *Bacill., p. 99. 1844.*

Pinnularia decurrens Ehr. *Verb., p. 132, pl. 3, f. 5. 1843.*

Navicula gibba Ehr. *Abh., 1830, and Inf., p. 184, 1838,* is *Cystopleura gibba* (Ehr.) Kuntze.

Navicula gibba Kütz. *Bacill., p. 98, pl. 28, fig. 70. 1844.*

Pinnularia gibba Ehr. *Verb., 1843.*

Pl. 7, figs. 247–253.

Linear-elliptic, swollen in the middle and at the ends, the median inflation extending a considerable distance toward the ends, 50–95 μ long, 7–12 μ wide; costae slightly radiating in the center and converging at the ends, usually extending nearly to the raphe, but in the form var. *brevistriata* V. H. very much shortened and sometimes entirely lacking around the central nodule, 9–12 in 10 μ.

In rivers, ponds, etc., among filamentous algae: Clear Lake, Dismal River, Grand Island, Hackberry Lake, Halsey, Seneca, Snake River.
Fossil: Cherry County, Mullen.

12. **Navicula subcapitata** (Greg.) Ralfs in *Pritch. Inf., p. 902. 1845.*
Pinnularia subcapitata Greg. in *Mic. Jour., pl. 3, fig. 30. 1856.*
Navicula hilseana Janisch according to *Cleve Syn. Nav. Diat., II, p. 175.*
Pl. 8, figs. 254–259.
Linear, sometimes slightly constricted in the middle, with attenuate or capitate apices, 25–50 μ long, 5–9 μ wide; costae 9–18 in 10 μ, slightly radiate toward the middle, converging at the ends, lacking in the center, forming a pseudostauros.

In ponds and creeks: Ainsworth, Clear Lake, Hackberry Lake, Lincoln, Long Pine, Tekamah.
Fossil: Cherry County.
Devils Lake, N. Dak.

13. **Navicula appendiculata** (Ag.) Kütz. *Bacill., p. 93, pl. 3, fig. 28; pl. 4, fig. 2; pl. 5, fig. 5. 1844.*
Cymbella appendiculata Ag. *Icon. Alg. Eu., pl. 1. 1828.*
Pl. 8, figs. 260–263.
Linear or slightly lanceolate, often slightly constricted in the middle, 18–44 μ long, 4–8 μ wide; apices more or less rostrate-capitate; costae delicate, radiate in the center, converging at the ends, 13–18 in 10 μ, becoming shorter toward the center, where they are entirely lacking, leaving a pseudostauros. The specimen represented in fig. 262 is elliptical and broader than the type.

In creeks, ponds, tanks, etc.: Brock, Crete, Emerald, Rupert, Stromsburg.
Fossil: Loup City.
Turtle River, S. Dak.

14. **Navicula braunii** Grun. in *V. H. Syn., p. 79, pl. 6, fig. 21. 1885.*
Pl. 8, figs. 264–266.
Lanceolate, slightly swollen in the middle with ends more or less capitate, 35–50 μ long, 8–9 μ wide; costae radiate in the center, converging at the ends, extending nearly to the raphe at the ends, but

gradually shortened toward the center, where they are entirely lacking, leaving a large rectangular hyaline space, 11–12 in 10 μ.

In pools, ditches, etc.: Crete, Long Pine, Talmage.

15. **Navicula mesolepta** Ehr. *Amer., pl. 4, II, fig. 4. 1843.*
Navicula mesolepta Kütz. *Bacill., p. 101, pl. 28, fig. 73; pl. 30, fig. 34. 1844.*
Pl. 8, figs. 267–269, 271–272; pl. 22, fig. 837.
Lanceolate, triundulate with capitate ends, 22–62 μ long, 3–12 μ wide; costae radiate near the center, converging at the ends, lacking in the center, leaving a transverse hyaline space, 10–15 in 10 μ. The specimen represented in fig. 268 has shorter costae.

In lakes, creeks, rivers, ponds, etc.: Dunning, Grand Island, Hackberry Lake, Halsey, Lincoln, New Helena, O'Neill, St. Michael, Snake River, Thedford, Trenton, Whitman.
Fossil: Hay Springs, Merriman.
Fresno, Cal.; New Concord, Ohio.

16. **Navicula thermes** (Ehr.) A. Schm. *Atl., pl. 45, figs. 67–71. 1874.*
Pinnularia thermes Ehr. *Amer., pl. 2, VI, fig. 22. 1843.*
Navicula nodulosa Kütz. *Bacill., p. 101, pl. 3, fig. 57; pl. 28, fig. 71. 1844.*
Navicula interrupta W. Sm. *Brit. Diat., I, p. 53,* is a synonym of *N. didyma* Kütz.
Pl. 8, fig. 270; pl. 22, fig. 840.
Linear with parallel or slightly concave margins and capitate ends, 17–76 μ long, 12–13 μ wide; striations radiate near the center and converging at the ends, extending nearly to the raphe at the ends and gradually shortened toward the center, where they are entirely lacking, forming a rhomboidal hyaline space, 9–15 in 10 μ.

In rivers and pools: Ainsworth, Culbertson, Louisville, St. Paul, Thedford.
Fossil: Thedford.

17. **Navicula legumen** Ehr. *Amer., pl. 4, I, fig. 17. 1843.*
Pl. 8, figs. 273–278.
Linear or lanceolate, slightly triundulate, the undulations some-

times faint; apices capitate, 30–80 μ long, 10–16 μ wide; striations radiate in the center, converging at the ends, shortened, leaving a hyaline space along the raphe about one-third the width of the valve, 9–12 in 10 μ.

In springs, creeks, pools: Auburn, Brock, Broken Bow, Dismal River, Emerald, Grand Island, Hackberry Lake, Long Pine, Valentine, West Point.

Fossil: Agate, Cherry County, Loup City, Mullen.
Turtle River, Rosebud, S. Dak.; Cheyenne, Wyo.

18. **Navicula nodosa** Ehr. *Inf., p. 179, pl. XIII, fig. 9(?). 1838.*
Pl. 22, fig. 842.

Valves linear, from strongly triundulate and capitate to nearly straight and rostrate, 55–95 μ long, 9–12 μ wide; raphe fine, curved at the ends; striations 8–10 in 10 μ, slightly radiate at the center and converging at the ends, shortened, extending only a little more than one-fourth of the width of the valve, lacking opposite the central nodule.

In creek, New Helena.

19. **Navicula acrosphaeria** (Breb.) Kütz. *Bacill., p. 97, pl. 5, fig. 11. 1844.*
Frustulia acrosphaeria Breb. *Consp. Diat., p. 19. 1838.*
Pl. 8, fig. 279.

Linear, more or less gibbous in the middle, or straight and slightly swollen or constricted at the ends, 18–32 μ long, 7–20 μ wide; costae radiate near the middle and converging at the ends, lacking in the middle, forming a pseudostauros, 9–14 in 10 μ, shortened, leaving an axial area about one-third the width of the valve or extending nearly to the raphe, axial area granular.

Crawford: in pond, Orella.

II. Radiosae

A. Middle striations radiate, terminal converging.
b. Striations fine.
c. Terminal striations in broken lines. 20. *N. oblonga.*
cc. Striations in continuous lines.
d. Middle striations alternately long and short.
e. Broadly lanceolate.
f. Not rostrate-capitate.

g. More than 30 μ long.
21. *N. peregrina.*
gg. Less than 30 μ long.
22. *N. menisculus.*
ff. Rostrate-capitate. 23. *N. salinarum.*
ee. Narrowly lanceolate. 24. *N. cincta.*
dd. Middle striations not alternately long and short.
e. Middle striations equally shortened forming a pseudostauros. 25. *N. gracilis.*
ee. No pseudostauros.
f. Apices not rostrate-capitate.
g. Broadly lanceolate, central nodule surrounded by a large hyaline area.
h. Apices not rostrate.
26. *N. vulpina.*
hh. Apices rostrate.
27. *N. viridula.*
gg. Narrowly lanceolate, hyaline area small.
28. *N. radiosa.*
ggg. Elliptical-lanceolate.
29. *N. cryptocephala.*
ff. Apices rostrate-capitate.
g. Hyaline area elongated transversely.
29. *N. cryptocephala.*
gg. Hyaline area round.
30. *N. rhynchocephala.*
bb. Striations very coarse. 31. *N. hungarica.*
AA. Middle striations radiate, terminal perpendicular to the raphe.
b. Narrowly lanceolate, hyaline area not stauroneiform.
32. *N. digito-radiata.*
bb. Broadly lanceolate, elliptical, or oblong.
c. Broadly lanceolate, striations coarse, hyaline area stauroneiform.
33. *N. reinhardtii.*
cc. Small with fine striations, hyaline area rounded.
34. *N. minnewaukonensis.*
AAA. Striations all radiate.
b. Lanceolate to elliptical.
c. No pseudostauros. 35. *N. lanceolata.*
cc. With pseudostauros.
d. Middle striations alternately long and short.
36. *N. gastrum.*
dd. Middle striations not alternately long and short.
e. Capitate. 37. *N. anglica.*
ee. Not capitate. 38. *N. placentula.*
bb. Oblong.

c. Striations finely punctate.	39. *N. dicephala.*
cc. Striations coarsely punctate.	40. *N. amphibola.*

20. **Navicula oblonga** Kütz. *Bacill., p. 97, pl. 4, fig. 21. 1844.*
Frustulia oblonga Kütz. *Alg. Dec., No. 84. 1834.*
Navicula macilenta Ehr. *Inf., p. 183, pl. 21, fig. 13. 1838.*
Pl. 8, figs. 280–282; pl. 22, fig. 843.

Oblong-linear, 92–160 μ long, 14–17 μ wide; margins from center to apices convex or straight, very slightly constricted below the broadly rounded apices; raphe distinct but delicate; striations 6–8 in 10 μ, all radiating at an angle of 45°, except a few at the ends, which are converging, flexuous, those near the ends abruptly broken, shortened opposite the central and terminal nodules, leaving circular areas.

Common among higher algae and also as fossil: Andrews, Anselmo, Benkleman, Big Alkali Lake, Cherry County, Dewey Lake, Dismal River, Dunning, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Lakeside, Long Pine, New Helena, North Platte, Pelican Lake, Rupert, St. Paul, Scottsbluff, Seneca, Thedford, Valentine, Wahoo, Wann, Whitman, Willow Lake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Wheeler County.

Cutmeat, Rosebud, Turtle River, S. Dak.; Court Lake, Devils Lake. Sully's Hill, N. Dak.; Cheyenne, Wyo.

21. **Navicula peregrina** (Ehr.) Kütz. *Bacill., p. 97, pl. 28, fig. 52. 1844.*
Pinnularia peregrina Ehr. *Amer., p. 133, pl. I, figs. 5–6. 1843.*
Pl. 8, figs. 283–289.

Elliptical to broadly lanceolate or rhomboidal, sometimes attenuate-rostrate, 34–80 μ long, 8–18 μ wide; striations very distinct, 6–12 in 10 μ, radiate in the center and converging at the ends, extending almost to the raphe, about 3–5 of the middle ones shortened, the alternate ones shorter, leaving a transverse hyaline space.

With higher algae in creeks and ponds: Callaway, Grand Island, Lincoln, Long Pine, North Platte, Red Cloud, Weeping Water.

Rosebud, S. Dak.

22. **Navicula menisculus** Schum. *Preuss. Diat., II, p. 56, pl. 2, fig. 33. 1864.*

Pl. 8, figs. 290–293.

Elliptical-lanceolate, 15–32 μ long, 5.5–13 μ wide, attenuate or attenuate-rostrate; striations radiate, becoming parallel or converging at the ends, 8–15 in 10 μ, closer at the ends than in the middle, the ones in the middle sometimes not much shortened.

In creeks and rivers: Grand Island, Long Pine, Ruby, Seneca.

23. **Navicula salinarum** Grun. *Arct. Diat., p. 33, pl. 2, fig. 34. 1880.*

Pl. 8, figs. 294–295.

Broadly lanceolate with capitate apices, 24–35 μ long, 7–15 μ wide; striations radiate in the middle and converging at the ends, 14–16 in 10 μ, shortened opposite the central nodule, leaving a circular hyaline space.

In pond, Ruby.
Little White River, S. Dak.

24. **Navicula cincta** (Ehr.) Ralfs in *Pritch. Inf., p. 901. 1861.* *Pinnularia cincta* Ehr. *Mikr., pl. 10.2, fig. 6. 1843.*

Pl. 8, figs. 296–298.

Elliptical-lanceolate, 20–40 μ long, 5–7 μ wide, from narrowly to broadly rounded at the apices; striations usually indistinct, about 12 in 10 μ, the middle ones more distant, radiate except at the ends, where they are converging, slightly shortened around the central nodule, leaving a small transverse hyaline space.

Var. *heufleri* Grun. and var. *leptocephala* Breb. appear to be mere forms.

In fresh and brackish water: Arbor, Fairbury, Grand Island, Long Pine, Louisville, Nebraska City, Nemaha City, Orella, Pawnee City, Peru, Salem, Talmage, Weeping Water.
Devils Lake, N. Dak.

25. **Navicula gracilis** Kütz. *Bacill., p. 91, pl. 3, fig. 48; pl. 30, fig. 57. 1844.*

Pl. 8, figs. 299–303.

Narrowly lanceolate, 38–80 μ long, 8–10 μ wide, apices acute; striations 10–12 in 10 μ, radiate in the center, then straight, and

converging at the ends, those opposite the central nodule equally shortened.

In creeks and rivers: Crawford, Grand Island, Hackberry Lake, Oakdale, Seneca.

26. **Navicula vulpina** Kütz. *Bacill., p. 92, pl. 3, fig. 43. 1844.*
Pl. 22, fig. 825.

Lanceolate, ends obtuse or slightly attenuate, 75–140 μ long, 14–16 μ wide; striations radiate in the center, converging at the ends, shortened opposite the central nodule, leaving a rectangular space, 10–11 in 10 μ.

Fossil in Pliocene stratum: Valentine.
New Concord, Ohio.

27. **Navicula viridula** Kütz. *Bacill., p. 91, pl. 30, fig. 47; pl. 4, figs. 10, 15. 1844.*
Pl. 8, fig. 304.

Broadly lanceolate, 33–70 μ long, 7–10 μ wide, apices tapering, rostrate; striations 8–14 in 10 μ, radiate in the middle, converging at the ends, shortened around the central nodule, leaving a round hyaline space.

In watering trough, Cheyenne, Wyo.

28. **Navicula radiosa** Kütz. *Bacill., p. 91, pl. 4, fig. 23. 1844.*
Pl. 8, figs. 305–311.

Lanceolate, 30–70 μ long, 7–12 μ wide, margin from center to ends convex, straight, or concave, but attenuate at the ends; striations radiate in the middle, slightly curved, converging at the ends, extending nearly to the raphe, but slightly shortened opposite the central nodule, 9–12 in 10 μ. Includes *N. radiosa* var. *acuta* (W. Sm.) Grun.

In creeks and rivers, also fossil: Andrews, Anselmo, Bellevue, Benkleman, Crawford, Culbertson, Dismal River, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Lincoln, Long Pine, Meadow, New Helena, North Platte, Oakdale, Orleans, Red Cloud, St. Michael, St. Paul, Snake River, South Bend, Thedford, Trenton, Valentine, Whitman, Woodlake, Woodlawn.

Fossil: Agate, Greeley County, Loup City, Merriman, Mullen, Valentine, Williams's Canyon.

Belvidere, Blackpipe, Little White River, Rosebud, Turtle River, S. Dak.; Court Lake, fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Emporia, Kansas.

29. **Navicula cryptocephala** Kütz. *Bacill., p. 95, pl. 3, figs. 20–26. 1844.*

Pl. 9, figs. 312–318.

Lanceolate to elliptical, 23–37 μ long, 7–9 μ wide, from slightly or not at all attenuate to rostrate-capitate; striations radiate in the center and converging at the ends, 12–18 in 10 μ. Includes *N. cryptocephala* var. *veneta* (Kütz.) Rabenh.

Very common in creeks, tanks, springs, also fossil: Andrews, Anselmo, Arbor, Ashland, Auburn, Aspinwall, Bellevue, Benkleman, Big Alkali Lake, Brock, Brownlee, Burge, Central City, Clear Lake, Columbus, Crawford, Culbertson, Dawson, Dismal River, Dunning, Durly Lake, Emerald, Emmett, Fairbury, Falls City, Fremont, Grand Island, Hackberry Lake, Haigler, Hemingford, Humboldt, Hyannis, Julian, Lakeside, Lincoln, Little Alkali Lake, Lodi, Long Lake, Long Pine, Louisville, Mason City, New Helena, Newport, Norfolk, North Platte, Omaha, O'Neill, Orella, Orleans, Pawnee City, Peru, Phalaris Lake, Pleasant Dale, Red Cloud, Rulo, Rupert, St. Michael, St. Paul, Scottsbluff, Seneca, Seward, Stanton, Stromsburg, Talmage, Tecumseh, Tekamah, Thedford, Trenton, Valentine, Wahoo, Wann, Weeping Water, West Point, Whitman, Woodlake.

Fossil: Cherry County, Hay Springs, Merriman, Thedford.

Belvidere, Blackpipe, Conata, Imlay, Kadoka, Little White River, Redleaf, Weta, Rosebud, S. Dak.; Court Lake, Devils Lake, fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Ft. Collins, Colo.; New Concord, Ohio.

30. **Navicula rhynchocephala** Kütz. *Bacill., pl. 30, fig. 35. 1844.* *Navicula rhynchocephala* (Kütz.) W. Sm. *Brit. Diat., I, p. 47. 1853.*

Pl. 9, figs. 320–324.

From broadly lanceolate to linear-elliptical, 23–60 μ long, 7–10 μ wide, varying from attenuate to rostrate-capitate; striations 9–15 in 10 μ, more distant in the center than at the ends, radiate throughout nearly the length of the valve, converging at the ends. Includes *N. rhynchocephala* var. *rostellata.*

In springs and creeks with *Spirogyra* and other algae: Fairbury, Orella. Turtle River, S. Dak.

31. **Navicula hungarica** Grun. in *Wien. Verh., p. 530, pl. 1, fig. 30. 1860.*

Navicula humilis Donk. *Brit. Diat., p. 67, pl. 10, fig. 7. 1872.*

Pl. 9, figs. 325–326.

Linear-elliptical, inflated in the middle, 15–20 μ long, 5–6 μ wide; apices rostrate to rostrate-capitate; striations coarse, about 8 in 10 μ, radiate in the center and converging at the ends, extending almost to the raphe.

In rivers, creeks, and ponds, also fossil: Andrews, Cody Lake, Crawford, Fremont, Gordon Creek, Grand Island, Halsey, Lodi, Long Pine, Louisville, New Helena, Norfolk, Pelican Lake, Pleasant Dale, Ruby, Rupert, St. Paul, Seward, Snake River, Stanton, Stromsburg, Valentine, West Point.

Fossil: Cherry County.

Devils Lake, N. Dak.; Rosebud, S. Dak.; Ft. Collins, Colo.; Rio Grande, Ohio.

32. **Navicula digito-radiata** (Greg.) Ralfs in *Pritch. Inf., p. 901. 1861.*

Pinnularia digito-radiata Greg. in *Quart. Jour. Mic. Soc., p. 9, pl. 1, fig. 32. 1856.*

Pl. 9, figs. 327–328.

Lanceolate or somewhat oblong, 45–80 μ long, 7–12 μ wide, apices more or less obtuse; striations 8–10 in 10 μ, shortened opposite the central nodule, longer striations alternating with shorter, radiate in the middle, perpendicular to the raphe at the ends.

In rivers: Benkleman, Crawford, Grand Island, Scottsbluff.

Belvidere, Blackpipe, Rapid City, S. Dak.; Blackhand, Muskingum River, New Concord, Ohio.

33. **Navicula reinhardtii** Grun. *Arct. Diat., p. 32. 1880.*

Pl. 9, figs. 329–330; pl. 22, fig. 839.

Oblong, elliptical, or lanceolate, 35–95 μ long, 10–20 μ wide, sometimes attenuated toward the obtusely rounded apices; striations 7–10 in 10 μ, radiate in the middle, becoming perpendicular to the raphe at the ends, shortened, leaving a narrow space along the raphe, 2–4 opposite the central nodule shorter, longer striations alternating with shorter ones, leaving a round central space.

In creeks, also fossil: Fairbury, Gordon Creek, Grand Island, Long Pine.

Fossil: Agate.
Little White River, S. Dak.

34. **Navicula minnewaukonensis** n. sp.

Pl. 9, figs. 331–332.

Broadly lanceolate, oblong, or elliptical, 15–20 μ long, 4–6 μ wide; sometimes slightly constricted below the rounded apices; striations 15–16 in 10 μ, all radiating except those at the ends, which are perpendicular to the raphe, those in the center slightly shortened, leaving a very small rounded area.

In sand on shore of Bird Island, Devils Lake, N. Dak.

35. **Navicula lanceolata** Kütz. *Bacill., p. 94, pl. 28, fig. 38; pl. 30, fig. 48. 1844.*

Pl. 9, figs. 333–336; pl. 22, fig. 841.

Lanceolate or sometimes almost elliptical, 30–50 μ long, 7–11 μ wide, a form at Stockton, Cal., 15 μ long, 5.5 μ wide; apices more or less rostrate; striations 11–12 in 10 μ, closer at the ends than in the middle, shortened around the central nodule, leaving a round hyaline space, all radiate. One specimen found, fig. 333, is 75 x 16 μ with 9 striations in 10 μ. Sometimes found in the craticulate resting condition as described for *N. cuspidata* and *N. ambigua*. The cells are occasionally found cohering in bands. Fig. 334 and fig. 335 represent a very small form, 13 μ long.

Very common in pools, creeks, stagnant ditches, tanks, etc., also fossil: Alma, Andrews, Anselmo, Arago, Ashland, Aspinwall, Auburn, Bellevue, Benkleman, Blue Springs, Broken Bow, Cairo, Callaway, Central City, Cedar Creek, Cody Lake, Crawford, Crete, Culbertson, Dawson, Dewey Lake, Dismal River, Dunning, Emerald, Glen Rock, Gordon Creek, Grand Island, Haigler, Halsey, Hastings, Julian, Lincoln, Long Pine, Louisville, Milford, New Helena, Norfolk, North Platte, Oakdale, O'Neill, Orleans, Paul, Pelican Lake, Peru, Pleasant Dale, Red Cloud, Ruby, Rulo, Rupert, St. Libory, St. Michael, St. Paul, Salem, Scottsbluff, Seneca, Seward, Snake River, South Bend, Stanton, Stromsburg, Talmage, Thedford, Trenton, Valentine, Wann, Watts Lake, Weeping Water, West Point.

Fossil: Agate, Cherry County, Loup City.

Court Lake, Devils Lake, N. Dak.; Blackpipe, Cutmeat, Dallas, Interior, Kadoka, Little White River, Rapid City, Redleaf, Rosebud, S. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Ft. Collins, Colo.; Blackhand, New Concord, Rodney, Ohio; Emporia, Kansas.

36. **Navicula gastrum** Ehr. *Amer., p. 133, pl. 3, VII, fig. 23. 1843.*

Pl. 9, figs. 337–338, 344.

Elliptical with apices varying from broadly rounded to capitate, 25–45 μ long, 11–17 μ wide; striations all radiate, 8–11 in 10 μ, those around the central nodule alternately long and short, leaving a round or transversely elongated hyaline space.

In creeks, ponds, and rivers, usually with higher algae, also fossil: Benkleman, Big Alkali Lake, Brownlee, Burge, Central City, Cody Lake, Crawford, Dismal River, Dunning, Gordon Creek, Grand Island, Haigler, Hyannis, Long Pine, Norfolk, North Platte, Phalaris Lake, Red Cloud, St. Paul, Seneca, Stanton, Trenton, Valentine, Wann, Watts Lake, West Point.

Fossil: Agate, Loup City, Merriman.

Cheyenne, Wyo.; Little White River, Rapid City, S Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Blackhand, Ohio.

37. **Navicula anglica** Ralfs in *Pritch. Inf., p. 900. 1861.*

Pl. 9, figs. 339–343.

Elliptical with capitate ends, 23–40 μ long, 8–14 μ wide; striations all radiate, 9–15 in 10 μ, shorter around the central nodule, but not alternately longer and shorter. Fig. 342 is a small specimen, 14 μ long, with 20 striations in 10 μ.

Common with other algae in creeks, rivers, ditches, ponds, etc.: Andrews, Anselmo, Ashland, Benkleman, Burge, Cedar Creek, Central City, Cherry County, Clear Lake, Crawford, Dismal River, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Ithaca, Long Pine, Louisville, New Helena, Oakdale, Omaha, Pelican Lake, Red Cloud, St. Paul, Seneca, Snake River, South Bend, Thedford, Valentine, Wann, Willow Lake.

Blackpipe, Little White River, Rosebud, Turtle River, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Chippewa Falls, Wis.; Blackhand, Muskingum River, New Concord, Put-in Bay, Rodney, Ohio.

38. **Navicula placentula** (Ehr.) Kütz. *Bacill., p. 94, pl. 28, fig. 57. 1844.*

Pinnularia placentula Ehr. *Amer., p. 133, pl. 3, VII, fig. 22. 1843.*

Pl. 9, fig. 345.

Elliptical with apices varying from broadly rounded to capitate, 23–60 μ long, 8–28 μ wide; striations all radiate, 6–10 in 10 μ,

shortened around the central nodule, but not alternately long and short, distinctly punctate, sometimes coarsely so.

Among other algae in creeks, rivers, and ponds, also fossil: Grand Island.

Fossil: Mullen.

Turtle River, S. Dak.

Professor Cleve, *Syn. Nav. Diat., II, p. 23,* says of these three species: "*Navicula placentula* is very nearly akin to *Navicula gastrum*, and it is questionable whether they should not be united into one species. The median striae are in *Navicula gastrum,* but not in *Navicula placentula*, alternately longer and shorter, but this characteristic is subject to great variation, the variety *jenisseyensis* having only a few, and the variety *latiscula* no shorter median striae. Of more importance is it that *Navicula placentula* has coarsely lineate, or almost punctate striae. *Navicula anglica* is nearly akin to *Navicula gastrum* and might be considered a variety of it. There exists, in fact, no limit between these three species. * * * On the other hand, *Navicula placentula* is by its coarsely punctate striae allied to the section *Punctatae,* among which *Navicula amphibola* is nearly akin to *Navicula placentula*. Smaller forms of *Navicula gastrum* closely resemble smaller forms of *Navicula peregrina* var. *menisculus,* from which they differ by the terminal striae being radiate throughout, but this characteristic is sometimes exceedingly delicate."

30. **Navicula dicephala** (Ehr.) Kütz. *Bacill., p. 96, pl. 28, figs. 60, 62. 1844.*

Pinnularia dicephala Ehr. *Inf., p. 185. 1838.*

Pl. 9, figs. 346–350.

Linear to linear-lanceolate, with rostrate-capitate ends, 17–40 μ long, 5–12 μ wide; striations granular, 8–12 in 10 μ, all radiate, those around the central nodule usually shortened, but not alternately, leaving a transverse hyaline space.

In creeks, lakes, rivers, also fossil: Andrews, Anselmo, Benkleman, Brownlee, Central City, Clear Lake, Cody Lake, Crawford, Dismal River, Dunning, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Holbrook, Long Pine, Louisville, New Helena, Norfolk, Oakdale, O'Neill, Orella, St. Paul, Seneca, Snake River, Thedford, Valentine, Wann, West Point, Whitman.

Fossil: Agate, Cherry County, Hay Springs, Loup City, Merriman, Mullen, Thedford, Valentine, Williams's Canyon.

Little White River, Rapid City, Rosebud, Turtle River, S. Dak.; Cheyenne, Wyo.; Sully's Hill, N. Dak.

40. **Navicula amphibola** Cl. *Diat. of Finl., p. 33, 1891.*
Navicula punctata asymmetrica Lagerst. *Diat. of Spetz. 1873.*
Navicula gastrum styriaca Grun. *Diat. Oest. und Franz Josef Land.*

Pl. 9, figs. 353–355.

Valves elliptic-lanceolate, 37–70 μ long, 23–27 μ wide; apices varying from acuminate to rostrate-capitate; striations radiate, 5–10 in 10 μ, coarsely punctate, puncta 12–15 in 10 μ; striations extending nearly to the raphe, about three of the central ones shortened opposite the central nodule, leaving a transverse space slightly broader outward.

Dismal River, Hackberry Lake, Loup River at Thedford.

Fossil: Agate, Cherry County, Hay Springs, Merriman, Valentine, Williams's Canyon.

3. Lyratae

41. **Navicula pygmaea** Kütz. *Spec. Alg., p. 77. 1849.*

Pl. 9, figs. 356–359.

Elliptical, sometimes slightly attenuate at the ends, 20–45 μ long, 8–12 μ wide; striations finely punctate, 18–26 in 10 μ, nearly perpendicular in the middle and becoming radiate at the ends, interrupted on each side of the raphe by a sulcus which nearly touches the raphe in the middle and at the ends and is curved outward between these points. Cells often cohering, forming short filaments.

In stagnant or running water with *Oscillatoria,* etc.: Culbertson, Dismal River, Dunning, Grand Island, Humboldt, Lincoln, New Helena, Norfolk, Pleasant Dale, Rupert, St. Paul, Salem, Seward, Stanton, Stromsburg, Talmage, Trenton, Weeping Water, West Point.

Stockton, Cal.; Devils Lake, N. Dak.

4. Stauroneideae

A. Striations more distant in center.
  b. Elliptical. 42. *N. crucicula.*
  bb. Margins undulate. 43. *N. integra.*
AA. Striations lacking in the center. 44. *N. rotacana.*

42. **Navicula crucicula** (W. Sm.) Donkin. *Brit. Diat., p. 44, pl. 6, fig. 11. 1871.*

Stauroneis crucicula W. Sm. *Brit. Diat., I, p. 60, pl. 19, fig. 192. 1853.*

Pl. 9, figs. 360–362; pl. 22, fig. 829.

Lanceolate or lanceolate-elliptic with apices obtuse, sometimes attenuate, 26–70 μ long, 8–20 μ wide; striations extending almost to the raphe, slightly or much shortened opposite the central nodule, where they are coarser and slightly more distant than the others, giving the appearance of a stauros, the others radiate, or at the ends transverse, finely punctate, 16–18 in 10 μ.

In salt marsh, Arbor; damp ground, Long Pine.

43. **Navicula integra** (W. Sm.) Ralfs in *Pritch. Infusoria, p. 895. 1861.*

Pinnularia integra W. Sm. *Brit. Diat., II, p. 96. 1856.*

Pl. 22, fig. 838.

Elliptical-lanceolate with a constriction near each end, and rostrate-apiculate ends, 23–38 μ long, 8–9 μ wide; striations about 23 in 10 μ, more distant in the middle, reaching nearly to the raphe.

In Prairie Creek, Grand Island.

44. **Navicula rotaeana** (Rabenh.) Cleve. *Nav. Diat., II, p. 128. 1894.*

Stauroneis rotaeana Rabenh. *Hedw., I, p. 103, pl. 13, fig. 7. 1852.*

Stauroneis minutissima Lagerst. *Spetsb. Diat., p. 39, pl. I, fig. 13. 1873.*

Stauroneis ovalis Greg. *M. J., IV, pl. I, fig. 36. 1856.*

Stauroneis colnii Brun. *Diat. des Alpes, p. 91, pl. IX, fig. 10. 1880.*

Pl. 22, fig. 828.

Elliptical, 13–24 μ long, 6–8 μ wide, apices rounded; striations radiate, about 28 in 10 μ, shortened in the center, leaving a pseudostauros which extends nearly to the margins.

In lake in Estes Park, Colo.

5. Palpebrales

45. **Navicula palpebralis** Breb. in *W. Sm. Brit. Diat., I, p. 50, pl. 31, fig. 273. 1853.*

Pl. 9, figs. 363–365.

Elliptic-lanceolate with acute apices, 27–80 μ long, 8–16 μ wide; striations radiate, very short, leaving a lanceolate hyaline space along the raphe, 10–15 in 10 μ. This species is described as marine, but Schönfeldt, *Bacill. Oest. und Schw.*, p. 99, describes a fresh-water form of it.

In creeks, Ithaca, Ruby, St. Paul.

6. Perstriatae

A. With coarse puncta. 46. *N. lacustris.*
AA. With fine puncta. 47. *N. scutum.*

46. **Navicula lacustris** A. Sch. *N. D., p. 88, pl. 1, fig. 9. 1874.*
Navicula scandanavica (Lag.) Cl. *Syn. Nav. Diat., II, p. 48. 1895.*
Stauroneis scandanavica Lagerst. *Bohuls. Diat., p. 47. 1876.*

Pl. 9, fig. 366.

Elliptic-lanceolate with apices rostrate, 41–105 μ long, 14–34 μ wide; striations slightly radiate, punctate, extending nearly to the raphe and leaving a very narrow space along it, but shortened opposite the central nodule, leaving a rectangular hyaline space, 12–15 in 10 μ.

In Devils Lake, N. Dak.

47. **Navicula scutum** Schum. in *Königs. Schrift., p. 188, pl. 9, fig. 45. 1863.*

Pl. 9, fig. 367.

Elliptical or lanceolate-elliptical, 30–33 μ long, 10–11 μ wide, apices not attenuate; striations slightly radiate, finely punctate, 16–18 in 10 μ, shortened, leaving a broad irregular hyaline space along the raphe, considerably broader opposite the central nodule.

In creek, Broken Bow; Fremont, Grand Island; pond, Pleasant Dale.

7. Crassinerves

A. Apices not capitate.
b. Lanceolate.
c. Apices rounded, about 11 striations in 10 μ.
48. *N. guatamalensis.*

cc. Apices acute, about 14 striations in 10 μ.
49. *N. fulva.*
bb. Rectangular, apices abruptly pointed. 50. *N. mucronata.*
AA. Apices capitate. 51. *N. ambigua.*

46. **Navicula guatamalensis** Cl. & Grun. in *Le Diatomiste, II, p. 144, pl. 9, fig. 2.*

Pl. 10, fig. 368.

"Linear-lanceolate, obtuse at the ends, length 115–202 μ, breadth 18–32 μ; median line straight, bordered by a narrow axial area; terminal fissures curved in the same direction; with transverse and longitudinal striations, the transverse parallel, 11 in 10 μ, the longitudinal 23 in 10 μ. Hab. fresh water, Guatamala, fossil." "It is quite near *N. cuspidata* and differs from it in outline and finer striation." Our specimens agree with the description except that in size they are from 124 to 211 μ long and from 27 to 34 μ wide with 10 striations in 10 μ.

With *Chara* in Phalaris Lake and at Whitman.

49. **Navicula fulva** (Nitz.) Ehr. *Inf., p. 177, pl. 13, fig. 6. 1838.*
Bacillaria fulva Nitz. *Beitr., p. 87, pl. 3, fig. 19. 1817.*
Navicula cuspidata Kütz. *Bacill., p. 94, pl. 3, figs. 24, 37. 1844.*

Pl. 10, figs. 369–373, 378–380, 382.

Broadly lanceolate, 31–200 μ long, apices slightly enlarged or acuminate; striations nearly perpendicular to the raphe, slightly radiate, about 14 in 10 μ, extending nearly to the raphe, leaving a very narrow space which is slightly enlarged opposite the central nodule.

Common in creeks, ponds, tanks, etc.: Ainsworth, Andrews, Arago, Aspinwall, Auburn, Broken Bow, Central City, Cherry County, Clear Lake, Columbus, Culbertson, Dewey Lake, Dismal River, Dunning, Emerald, Emmett, Fremont, Grand Island, Hackberry Lake, Haigler, Halsey, Hemingford, Holt County, Hyannis, Johnson, Julian, Lakeside, Lincoln, Long Lake, Long Pine, Milford, Minden, New Helena, Norfolk, North Platte, O'Neill, Orella, Orleans, Pelican Lake, Peru, Pleasant Dale, Red Cloud, Rupert, Rulo, St. Paul, Seward, Sheridan County, Snake River, Stanton, Stromsburg, Talmage, Thedford, Trenton, Valentine, Wann, Weeping Water, West Point, Whitman.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Merriman, Mullen, Thedford, Valentine, Wheeler County.

Belvidere, Interior, Little White River, Norris, Rosebud, S. Dak.; Court Lake, Devils Lake, fresh water near Devils Lake, N. Dak.; Stockton, Cal.; Ft. Collins, Colo.

50. **Navicula mucronata** n. sp.

Pl. 10, fig. 387.

Rectangular, 40–50 μ long, 14–16 μ wide, apices abruptly pointed; striations nearly perpendicular to the raphe, slightly radiate, about 15 in 10 μ, extending nearly to the raphe, leaving a narrow space which is slightly enlarged opposite the central nodule.

In roadside ditch and in Wood River at Grand Island, and in Cody Lake in Cherry County.

51. **Navicula ambigua** Ehr. *Verb., p. 129, pl. 2, fig. 9. 1843.*

Pl. 10, figs. 374–377, 381, 383–386, 388.

Like *N. fulva,* but usually smaller and with rostrate-capitate apices. Van Heurck, *Diat., p. 214,* states that *N. ambigua* is probably only a variety of *N. fulva* (*cuspidata*), but gives it a place as a species. But Schönfeldt, *Diat. Oest. und Schw., p. 76,* makes it only a variety. The two forms occur together with all gradations between them, making it appear as if they were only forms of the same species. But the resting condition described for *N. fulva* occurs also in *N. ambigua.* This condition, as far as observed, occurs only in the typical forms of the two species and never in any of the intermediate forms except possibly in the form represented in fig. 382, and this would indicate that the two species are distinct, for a sporangial condition would not be likely to be found in any but mature forms.

Common in creeks, ponds, tanks, etc.: Alma, Andrews, Anselmo, Ashland, Bellevue, Brock, Broken Bow, Brownville, Central City, Clear Lake, Cody Lake, Columbus, Crawford, Crete, Culbertson, Dismal River, Dunning, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey, Hemingford, Holbrook, Humboldt, Johnson, Lakeside, Lincoln, Little Alkali Lake, Louisville, Nebraska City, New Helena, Norfolk, North Platte, Oakdale, Omaha, O'Neill, Orella, Peru, Pleasant Dale, Red Cloud, Rupert, Ruby, St. Michael, St. Paul, Scottsbluff, Seneca, Seward, Sheridan County, Snake River, Stanton, Stromsburg, Talmage, Tecumseh, Tioga, Trenton, Valentine, Wahoo, Wann, Weeping Water, West Point, Whitman.

Fossil: Agate, Cherry County, Greeley County, Merriman, Mullen, Thedford, Valentine.

Belvidere, Blackpipe, Conata, Cutmeat, Interior, Kadoka, Little White River, Norris, Rapid City, Rosebud, Scenic, Weta, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.

A form described as *N. cuspidata forma craticula* is found commonly with normal forms. In this condition there are about 4 heavy lines in 10 μ besides the striations, connecting the thickened margins with the heavy line along the raphe. These specimens are identical in form with ordinary specimens of the species and the arrangement of the endochrome is similar. I have never observed them in motion. On January 13, 1896, I found a specimen in this condition collected in a watering tank at Talmage, Nebraska, on December 26, 1895. The endochrome was diffused through the entire cell. After watching a few minutes the two valves separated, showing a new cell between them with ordinary valves. After the forming of the new cell the old cell contained two vacuoles and part of the endochrome which did not enter into the new diatom. The new diatom was of practically the same size as the old one. In the same collection another diatom had four oil globules in each half of the cell, two large and two small, the larger ones next to the center and the smaller ones at the ends. In this collection there was one specimen of this form to about a dozen in the normal condition. Fig. 382 shows a specimen with 8–9 very radiating striations in 10 μ in addition to the ordinary striations. De Toni, *Syll. Alg., II, sec. 1, p. 6,* refers to this as an "abnormal state." It has been called *Stictiodesmis craticula* Grev. and *Surirella craticula* Ehr.

8. Sculptae

A. Apices rostrate or regular; longitudinal sulcus broad.
52. *N. rostrata.*

AA. Apices rostrate-capitate; longitudinal sulcus narrow.
53. *N. sphaerophora.*

52. **Navicula rostrata** Ehr. in *Ber., p. 18. 1840.*
Navicula sculpta Ehr. *Mikro., pl. 10, I, fig. 5. 1854.*
Pl. 11, figs. 390–397; pl. 22, fig. 835.

Elliptic with apices sometimes tapering, obtuse, 57–114 μ long, 21–36 μ wide (one specimen was only 33 μ long); striations punctate, 12–16 in 10 μ, radiate, interrupted by a longitudinal sulcus, leaving a single row of puncta next to the raphe, the puncta closer near the margin of the valves; also interrupted by a transverse sulcus forming a pseudostauros which usually extends much nearer one margin of the valve than the other. The typical specimens of this species have rostrate apices, but many are regularly elliptic. These elliptic forms seem to belong to *N. polygramma*, a species which Cleve, *Nav. Diat., II, p. 6,* states is a form of *N. sculpta* (*rostrata*). Many of the specimens from Devils Lake have the regularly rhomboidal form shown in fig. 392.

In fresh or brackish water, usually where diatom conditions are good, also fossil: Anselmo, Big Alkali Lake, Clear Lake, Dismal River, Hackberry Lake, Halsey, Lakeside, Little Alkali Lake, North Platte, Orella, St. Paul, Sheridan County, Snake River, Thedford, Valentine, Whitman.

Fossil: Greeley County, Hay Springs, Loup City, Mullen, Spalding, Thedford.

Devils Lake and fresh water near Devils Lake, N. Dak.

53. **Navicula sphaerophora** Kütz. *Bacill., p. 95, pl. 4, fig. 17. 1844.*

Pl. 11, figs. 398–400.

Elliptic- or oblong-lanceolate with rostrate-capitate apices, 32–55 μ long, 10–20 μ wide; striations radiate, punctate, interrupted by a longitudinal sulcus which is narrower than in *N. rostrata*, and by a transverse sulcus that forms a pseudostauros, about 16 in 10 μ. Differs from *N. rostrata* in its narrower longitudinal sulcus, capitate apices, and usually smaller size.

In creeks, rivers, etc., usually with other algae, also fossil: Arago, Brock, Broken Bow, Brownlee, Cherry County, Clear Lake, Dismal River, Dunbar, Fremont, Grand Island, Hackberry Lake, Halsey, Humboldt, Julian, Long Pine, New Helena, Peru, Phalaris Lake, Ruby, St. Paul, Salem, Seneca, Sheridan County, Talmage, Valentine, Whitman.

Fossil: Greeley County, Loup City, Mullen, Thedford.

Blackpipe, Rosebud, S. Dak.

9. Serianteae

54. **Navicula serians** (Breb.) Kütz. *Bacill., p. 92, pl. 30, fig. 23; pl. 28, fig. 43. 1844.*

Frustulia serians Breb. *ex spec.*

Pl. 11, fig. 401; pl. 22, figs. 830–834.

Rhomboid- or oval-lanceolate, 31–80 μ long, 8–15 μ wide, apices acute or slightly rounded; striations slightly radiate, extending nearly to the raphe, about 24 in 10 μ, composed of rows of dots which also form zigzag longitudinal lines.

Lakeside, Thedford.
Fossil: Agate.

10. Formosae

Hyaline space slightly enlarged.	55. *N. liburnica.*
Hyaline space much enlarged.	56. *N. amphisbaena.*

55. **Navicula liburnica** Grun. *Wien. Verh., 10, p. 547, pl. 1, fig. 25. 1860.*

Pl. 11, figs. 402–403.

Elliptical-lanceolate, 82–100 μ long, 20–25 μ wide; striations radiate, interrupted by a sulcus near the margin, extending nearly to the raphe, slightly shorter opposite the central nodule, leaving an oval hyaline space, 12–16 in 10 μ.

In pool of hot water by old Burlington round house, Lincoln (fig. 402).
Fossil: Agate (fig. 403).

56. **Navicula amphisbaena** Bory. *Encyclop. Method. 1824.*

Pl. 11, fig. 404.

Broadly elliptic, 60–75 μ long, 22–25 μ wide, apices capitate; nodules distinct, the central one slightly lateral; hyaline area very broad, rhomboidal, leaving the striations much shortened; striations radiate, 12–15 in 10 μ, interrupted near the margin by a longitudinal sulcus.

In pool, North Platte; Benkleman.

11. Limosae

A. With a pseudostauros.	57. *N. ventricosa.*
AA. Without pseudostauros.	
b. With three slight inflations.	58. *N. silicula.*
bb. With three large inflations.	59. *N. trinodis.*

57. **Navicula ventricosa** Ehr. *Abh., p. 67. 1830.*

Pl. 11, figs. 405–418.

Linear or linear-elliptic, 22–69 μ long, 4–11 μ wide, apices

rounded; striations transverse or slightly radiate, 15–18 in 10 μ, lacking in the center, forming a pseudostauros. Var. *minuta* is probably only a small form of the same.

Among other diatoms, more often in ditches, muddy pools, etc.: Andrews, Brownlee, Callaway, Crete, Dunning, Fremont, Grand Island, Lakeside, Louisville, North Platte, Orella, Pleasant Dale, St. Paul, Scottsbluff, Seneca, Wann, West Point.

Fossil: Loup City.

Cutmeat, Turtle River, S. Dak.; Sully's Hill, N. Dak.; Chippewa Falls, Wis.

58. **Navicula silicula** Ehr. *Amer., p. 131. 1843.*

Navicula limosa Kütz. *Bacill., p. 101, pl. 3, fig. 50. 1844.*

Pl. 11, figs. 419–425.

Linear with three slight inflations, 15–85 μ long, 7–14 μ wide, apices obtuse, often somewhat apiculate; striations slightly radiate or nearly transverse, interrupted by a narrow sulcus parallel to the margins, not reaching to the raphe and often leaving a hyaline space along it one-third the width of the valve, more shortened opposite the central nodule, leaving a lanceolate or rounded space. Var. *gibberula* (figs. 424–425) is a form with larger inflations and closely connected with *N. trinodis*. Dried valves sometimes iridescent.

In ditches, etc., also fossil: Andrews, Ashland, Benkleman, Brownlee, Central City, Cody Lake, Crawford, Culbertson, Dismal River, Fremont, Gordon Creek, Grand Island, Halsey, Holt County, Lakeside, Lodi, Louisville, Mason City, Norfolk, North Platte, O'Neill, Orella, Pleasant Dale, Polk, Rupert, Ruby, Scottsbluff, Snake River, Stanton, Talmage, Tekamah, Thedford, Trenton, Valentine, Wann, West Point.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Thedford.

Blackpipe, Corn Creek, Rapid City, Redleaf, Rosebud, Turtle River, S. Dak.; fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.

59. **Navicula trinodis** Lewis. *Proceed. Acad. Nat. Sci., Phil., p. 66, pl. II, fig. 6. 1861.*

Pl. 11, figs. 426–428.

Linear with two constrictions making a median and two terminal inflations, 22–57 μ long, 7–15 μ wide, median inflation as wide as the terminal or wider, apices from broadly rounded to cuneate or attenuate; striations nearly parallel, tending to be perpendicular to

the margins, about 18 in 10 μ, not reaching to the raphe, leaving a hyaline space along the raphe considerably wider, and rounded opposite the central nodule. Dried specimens usually brownish.

In same locations as *N. silicula:* Alma, Andrews, Arago, Ashland, Auburn, Columbus, Crawford, Crete, Culbertson, Dismal River, Fremont, Gordon Creek, Grand Island, Halsey, Hyannis, Lincoln, Louisville, Milford, North Platte, Oakdale, Pleasant Dale, Rupert, St. Paul, Scottsbluff, Seneca, Stanton, Talmage, Thedford, Trenton, Valentine, Wann, Weeping Water, Whitman, Woodlawn.

Fossil: Loup City, Mullen.

Belvidere, Blackpipe, Corn Creek, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Ft. Collins, Colo.; Rio Grande, Ohio; Emporia, Kansas.

12. Affines

Van Heurck, *Syn., p. 221,* places all of these forms under *N. iridis.* Cleve, *Syn. Nav. Diat., I, p. 67,* states that all of these forms may be varieties of one species. Since there is no definite information as to the life history of the various forms, it seems best in the present work to retain the species as described.

A. Elongated, 3–6 times as long as wide.
- *b.* Margins parallel.
  - *c.* Ends rounded. — 60. *N. bisulcata.*
  - *cc.* Ends cuneate. — 61. *N. amphigomphus.*
  - *ccc.* Ends rostrate. — 62. *N. affinis.*
- *bb.* Margins convex, ends rounded or sub-rostrate. — 63. *N. iridis.*
- *bbb.* Margins undulating. — 62. *N. affinis.*

AA. Two to three times as long as broad. — 64. *N. dubia.*

60. **Navicula bisulcata** Lagerst. *Spetz. Diat., p. 31, pl. I, fig. 8. 1873.*

Pl. 12, fig. 429.

Linear, 40–70 μ long, 8–12 μ wide, apices rounded; raphe straight, the central ends bent in opposite directions; striations punctate, oblique, about 16 in 10 μ, interrupted near the margin of the valve by a deep sulcus, shortened opposite the central nodule, leaving a transversely elongated hyaline space. Dried valves usually brown.

In creeks, etc.: Andrews, Dunning, St. Paul, Thedford.

Fossil: Agate, Greeley County, Spalding.

61. **Navicula amphigomphus** Ehr. *Verb., p. 129, pl. 3, I, fig. 8. 1845.*

Pl. 12, figs. 430–432.

Broadly linear with cuneate ends, 68–150 μ long, 12–40 μ wide; raphe straight, the central ends bent in opposite directions; striations punctate, oblique, 15–18 in 10 μ, interrupted near the margin of the valve by a deep sulcus, shortened opposite the central nodule, leaving a transverse hyaline space. Dried valves usually brown.

In creeks, ponds, rivers, etc., also fossil: Auburn, Cody Lake, Crawford, Culbertson, Halsey, Lakeside, Norfolk, North Platte, Rupert, Seneca, Stanton, Stromsburg, Trenton, Whitman.

Fossil: Agate, Cherry County, Hay Springs, Loup City, Mullen, Spalding, Thedford, Wheeler County.

62. **Navicula affinis** Ehr. *Amer., p. 129, pl. 2, II, fig. 7. 1843.*

Pl. 12, figs. 433–437.

Linear, margins straight or undulating, 30–60 μ long, 8–15 μ wide, apices rostrate or capitate; raphe straight, the central ends bent in opposite directions; striations punctate, oblique, 16–18 in 10 μ, interrupted near the margin of the valve by a deep sulcus, slightly shortened opposite the central nodule, leaving a small rounded hyaline space. Dried valves usually brown.

In creeks, ponds, rivers, etc., also fossil: Andrews, Auburn, Blue Springs, Dismal River, Fremont, Grand Island, Hackberry Lake, Long Pine, New Helena, Talmage, Thedford, Valentine.

Fossil: Agate, Loup City, Mullen, Wheeler County.

Blackpipe, Rapid City, Rosebud, S. Dak.

63. **Navicula iridis** Ehr. *Amer., p. 130, pl. 4, I, figs. 1–2. 1843.*

Pl. 12, figs. 438–439.

Linear to elliptic, 26–170 μ long, 5–30 μ wide, apices rounded or somewhat attenuate; raphe straight, the central ends bent in opposite directions; striations granular, oblique, 15–17 in 10 μ, interrupted near the margin of the valve by a deep sulcus, shortened opposite the central nodule, leaving a transverse hyaline space. Dried valves usually brown.

In creeks, rivers, ponds, etc., also fossil: Andrews, Anselmo, Ashland, Atkinson, Auburn, Clear Lake, Culbertson, Dismal River, Dunning, Gor-

don Creek, Grand Island, Hackberry Lake, Halsey, Hemingford, Long Pine, Oakdale, Pelican Lake, Red Cloud, St. Paul, Seneca, Snake River, Thedford, Valentine, Wann, Whitman.

Fossil: Agate, Greeley County, Hay Springs, Loup City.

Belvidere, Little White River, Scenic, S. Dak.; Court Lake, N. Dak.; Stockton, Cal.

64. **Navicula dubia** Ehr. *Amer., p. 130, pl. II, 2, fig. 8. 1843.*

Pl. 12, fig. 440.

Elliptical, sometimes slightly biconstricted, 27–37 μ long, 10–12 μ wide; raphe straight, the central ends bent in opposite directions; striations punctate, oblique, 16–24 in 10 μ, interrupted near the margin of the valve by a deep sulcus, scarcely shortened opposite the central nodule. Dried valves usually brown.

Pool, Crete.

13. Bacilleae

A. Linear, terminal nodules not expanded laterally. 65. *N. bacilliformis.*
AA. Swollen in the middle; terminal nodules expanded laterally. 66. *N. pupula.*

65. **Navicula bacilliformis** Grun. in *Cl. & Grun. Arct. Diat., p. 44, pl. 2, fig. 51. 1880.*

Pl. 12, figs. 441–442; pl. 22, fig. 836.

Linear with broad rounded ends, sometimes slightly gibbous at the ends and in the middle, 30–45 μ long, 7–10 μ wide; striations slightly radiate, usually slightly converging at the ends, 12–16 in 10 μ, shortened opposite the central nodule, leaving a rectangular hyaline space about one-half the width of the valve.

In lakes, creeks, rivers, etc., also fossil: Ashland, Central City, Clear Lake, Columbus, Crete, Dunning, Fremont, Grand Island, Hackberry Lake, Hemingford, Long Pine, Louisville, O'Neill, Oakdale, St. Paul, Sheridan County, Stanton, Talmage, Thedford, Whitman.

Fossil: Loup City, Greeley County, Hay Springs, Merriman, Mullen.

Belvidere, Rosebud, S. Dak.; fresh water near Devils Lake, N. Dak.

66. **Navicula pupula** Kütz. *Bacill., p. 93, pl. 30, fig. 40. 1844.*

Pl. 12, figs. 443–447.

Linear, usually swollen in the middle and at the ends, 19–37 μ long, 7–9 μ wide, apices broadly rounded or nearly truncate; striations radiate, 18–23 in 10 μ, shortened opposite the central nodule,

leaving a rectangular hyaline space about one-half the width of the valve or sometimes extending across the entire width of the valve; terminal nodules expanded laterally. Cells often cohering in filaments.

In creeks, rivers, ponds, etc., especially with green algae, also fossil: Alma, Andrews, Ashland, Benkleman, Broken Bow, Brownlee, Burge, Clear Lake, Crawford, Culbertson, Dewey Lake, Dismal River, Dunning, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Lakeside, Long Pine, Louisville, Nebraska City, Norfolk, New Helena, North Platte, Oakdale, Orella, Orleans, Pleasant Dale, Red Cloud, Ruby, Rupert, St. Paul, St. Michael, Seneca, Seward, Snake River, Stanton, Stromsburg, Talmage, Thedford, Trenton, Valentine, Wann, West Point.

Fossil: Agate, Greeley County, Hay Springs, Loup City, Merriman, Spalding.

Little White River, S. Dak.; Stockton, Cal.

14. Minutissimae

A. Valves lanceolate. 67. *N. cocconeiformis.*
AA. Valves elliptical, very small.
b. Striations very fine. 68. *N. atomoides.*
bb. Striations coarser. 69. *N. mutica.*

67. **Navicula cocconeiformis** Greg. in *Quart. Jour. Mic. Soc., IV, p. 6, pl. 1, fig. 22. 1856.*

Pl. 12, fig. 448.

Elliptical or lanceolate, sometimes slightly swollen in the middle, 26–48 μ long, 9–13 μ wide; apices rounded or obtuse; striations slightly radiate, granular, those opposite the central nodule of unequal length, about 18 in 10 μ in the middle, 28–30 in 10 μ at the ends.

In creek, Humboldt.

68. **Navicula atomoides** Grun. in *V. H. Syn., p. 107, pl. 14, fig. 11. 1885.*

Navicula minima var. *atomoides* Cl. *Syn. Nav. Diat., II, p. 128. 1894.*

Pl. 12, figs. 449–450.

Elliptical or linear-elliptical, 8–12 μ long, 2.7–3 μ wide, ends rounded; striations slightly radiate, 27–30 in 10 μ, shortened opposite the central nodule, leaving a pseudostauros. Cells often united in bands of 3 or 4.

In tanks, etc.: Dunning, Grand Island, Hastings, Stromsburg. Fresno, Cal.

69. **Navicula mutica** Kütz. *Bacill., p. 93, pl. 3, fig. 32. 1844.*

Pl. 12, figs. 451–452.

Valves elliptical or elliptic-lanceolate, margins sometimes undulating, 13–33 μ long, 7–11 μ wide; striations radiate, 18–20 in 10 μ, several opposite the central nodule shortened, leaving a pseudostauros.

In rivers: Benkleman, Haigler, Long Pine, Orleans, West Point. Fresno, Cal.

20. Scolioplеura

Scolioplеura Grun. in *Wien. Verh., X, p. 554. 1860.*

Etym. from Gr. σκολιός, twisted, and πλευρά, side, referring to the form of the valve.

Like *Navicula*, but faces of the valves convex, spirally twisted, making the raphe and connecting zone sigmoid.

A. Large with coarse striations. 1. *S. tumida.*
AA. Smaller with finer striations. 2. *S. peisonis.*

1. **Scolioplеura tumida** (Breb.) Rabenh. *Fl. Eu. Alg., p. 229. 1864:*

Navicula tumida Breb. in *Kütz. Spec. Alg., p. 77. 1849.*

Pl. 13, figs. 472–473.

Lanceolate, 100–160 μ long, 20–25 μ wide (one specimen found was only 37 μ long); striations nearly perpendicular to the margins, extending nearly to the raphe, leaving a very narrow axial area, the central striations shortened, leaving an irregular space around the central nodule; cells twisted spirally, making the raphe slightly sigmoid; faces of the valves convex.

Fossil: Agate.

2. **Scolioplеura peisonis** Grun. *Verh., p. 554, pl. 3, fig. 25. 1860.*

Pl. 13, fig. 474.

Elliptical with rounded apices, 35–80 μ long, 10–18 μ wide; raphe sigmoid, enclosed between two longitudinal ridges which are at the ends of the striations; striations transverse, punctate, 12–16 in 10 μ.

In Devils Lake, N. Dak.

21. Stauroneis

Stauroneis Ehr. *Amer., p. 134. 1843.*

Etym. from Gr. σταυρός, cross, the transverse central nodule forming with the *rachis,* a cross.

Cells as in *Navicula,* but the central nodule broadened transversely into a "stauros" (cross). Frequently also with a transverse hyaline area bordering the stauros. Girdle with or without interzones; free or in a gelatinous envelope. Chromatophores as in *Navicula.* Auxospores single from two mother cells.

A. Margins not undulate.
  b. Apices not attenuate-rostrate.
    c. Cells without a lumen. — 1. *S. phoenicenteron.*
    cc. Cells with a lumen. — 2. *S. acuta.*
  bb. Apices attenuate-rostrate.
    c. Cells very small. — 3. *S. parvula.*
    cc. Cells of medium size. — 4. *S. anceps.*
AA. Margins undulate.
  b. Apices apiculate. — 5. *S. linearis.*
  bb. Apices rounded. — 6. *S. legumen.*

1. **Stauroneis phoenicenteron** Ehr. *Verb., pl. II, 5, fig. 1. 1843.*
Bacillaria phoenicenteron Nitz. *Beitr., pl. 3, figs. 12, 14. 1817.*
Pl. 12, figs. 453–455, 457–459.

Lanceolate, slightly attenuate, 62–266 μ long, 13–40 μ wide; apices obtuse, rounded, often slightly constricted; raphe consisting of a double line for the greater part of its length; stauros broad, extending to the margins of the valve, usually slightly dilated outward; striations granular, radiate, 14–18 in 10 μ, shortened, leaving a broad hyaline space along the raphe. A sporangial condition is shown in fig. 456.

In creeks, rivers, ponds, ditches, springs, tanks, etc., usually with other algae, also fossil: Andrews, Anselmo, Ashland, Atkinson, Broken Bow, Central City, Cherry County, Clear Lake, Crawford, Dismal River, Dunning, Grand Island, Hackberry Lake, Hemingford, Johnson, Lincoln, Lodi, Louisville, New Helena, North Platte, Oakdale, Orella, Pelican Lake, Peru, Plattsmouth, Ruby, St. Paul, St. Michael, Seneca, Snake River, Talmage, Tekamah, Thedford, Valentine, Wahoo, Wann.

Fossil: Cherry County, Greeley County, Loup City, Mullen, Valentine.

Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Sully's Hill, N. Dak.; New Concord, Rio Grande, Ohio.

2. **Stauroneis acuta** W. Sm. *Brit. Diat., I, p. 59, pl. 19, fig. 187. 1853.*

Pl. 12, figs. 456, 460.

Rhombic-lanceolate or gradually tapering from the middle to the narrow obtuse ends, or elliptical, 80–150 μ long, 15–40 μ wide; margins thickened at the ends, leaving a distinct diaphragm or lumen; raphe double for most of its length; stauros very broad, wider at the margins of the valve; striations granular, radiate, about 12 in 10 μ; cells usually united in short bands.

In spring, Brock; Dewey Lake, Hackberry Lake.

3. **Stauroneis parvula** Janisch. *Guano, p. 14. 1861.*

Pl. 12, figs. 461–462.

Linear-lanceolate or oblong, 12–25 μ long, 5–6 μ wide; apices more or less rostrate; stauros extending to the margins; striations radiate, granular, extending nearly to the raphe, 20–23 in 10 μ.

In creek, Anselmo; in bottle in laboratory, Grand Island; St. Paul, Valentine.

Fossil: Agate.

Rosebud, S. Dak.

4. **Stauroneis anceps** Ehr. *Amer., p. 134, pl. 2, I, fig. 18. 1843.*

Pl. 12, figs. 463–468.

Elliptical or elliptical-lanceolate with apices varying from rostrate to rostrate-capitate, 27–130 μ long, 6–17 μ wide; stauros broad, usually extending to the margins of the valve, slightly broader outward; striations radiate, granular, 14–20 in 10 μ, shortened, leaving a hyaline space along the raphe. Var. *amphicephala*, fig. 466, is more linear in form with capitate apices. Var. *linearis*, fig. 465, has rostrate apices. This species shows all gradations into *S. phoenicenteron*.

In pools, tanks, creeks, springs, etc., also fossil: Ainsworth, Andrews, Ashland, Auburn, Brock, Central City, Clear Lake, Columbus, Dismal River, Dunning, Emmett, Fairbury, Grand Island, Hackberry Lake, Halsey, Hemingford, Hyannis, Julian, Lincoln, Long Pine, Louisville, Milford, New Helena, Norfolk, Omaha, O'Neill, Orella, Peru, Red Cloud, St. Paul, Snake River, Talmage, Valentine, Wann, Weeping Water, West Point, Woodlake.

Fossil: Cherry County, Loup City, Merriman, Mullen.

Belvidere, Interior, Little White River, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Stockton, Cal.; New Concord, Rio Grande, Ohio.

5. **Stauroneis linearis** Ehr. *Amer., p. 135, pl. 1, fig. II, 11. 1843.*

Stauroneis smithii Grun. *Wien. Verh., p. 464, pl. VI, fig. 16. 1860.*

Pl. 12, fig. 469.

Oblong or lanceolate, 20–30 μ long, 7–8 μ wide, triundulate with middle inflation larger; stauros narrow, slightly wider at the extremities; apices apiculate; striations slightly radiate, about 30 in 10 μ; cells united in short bands.

In creeks, rivers, etc.: Arago, Dewey Lake, Dunning, Grand Island, Long Pine, Mason City, Tekamah, Thedford, Wahoo, Wann.
Fossil: Agate, Merriman.
Blackpipe, Rapid City, Rosebud, Turtle River, S. Dak.; Fresno, Cal.

6. **Stauroneis legumen** Ehr. *Abh., p. 135, pl. I, 2, fig. 5. 1844.*

Pl. 12, figs. 470–471.

Linear, triundulate, 21–35 μ long, 4.5–8 μ wide; apices rostrate-capitate; striations radiate, 27–30 in 10 μ; stauros reaching nearly to the margins, not dilated outward; cells united in short bands.

Gordon Creek, Red Cloud.
Fossil: Cherry County.

22. Diploneis

Diploneis Ehr. *1840.*

Usually short, constricted in the middle or not, usually with obtuse or rounded ends; fresh-water species elliptical; central nodule more or less quadrate, prolonged into horns or processes which lie parallel to the raphe. On both sides of the horns are depressions or furrows of more or less breadth. General structure like *Navicula,* except that the central nodule is prolonged.

Diploneis elliptica (Kütz.) Cl. *Syn. Nav. Diat., I, p. 92. 1894.* *Navicula elliptica* Kütz. *Bacill., p. 98, pl. 30, fig. 55. 1844.*

Pl. 13, figs. 475–482.

Oval-elliptic or oblong-elliptic, 12–55 μ long, 7–22 μ wide; raphe heavy, central nodule quadrangular with horns slightly curved; striations composed of puncta, 7–15 in 10 μ, nearly perpendicular to the margin of the valve. The forms called var. *oblongella* and var. *minima* are found.

In creeks, rivers, ponds, etc., among higher algae, also fossil: Benkleman, Brownlee, Burge, Central City, Crawford, Culbertson, Dismal River, Dunning, Johnson, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Holt County, Hyannis, Lincoln, Long Pine, Louisville, New Helena, North Platte, Omaha, St. Paul, Scottsbluff, Seneca, Stanton, Stromsburg, Tekamah, Trenton, Valentine, Wann.

Fossil: Agate, Loup City, Merriman, Spalding, Valentine.

Little White River, Weta, S. Dak.; Stockton, Cal.; Ft. Collins, Colo.

23. Achnanthes

Achnanthes Bory. *Dict. Class., I, p. 79, 593. 1822.*

Etym. from Gr. ἄχνη, point, and ἄνθος, flower.

Cells single or forming short chains attached by the basal cell, cells curved in girdle view; valves elliptical to lanceolate, often broader or narrower in the middle; valves dissimilar, the one concave with a true raphe and central and terminal nodules, the other convex with a pseudoraphe; both valves striate with transverse rows of dots, sometimes ribbed.

A. Lower valve with a pseudostauros. 1. *A. hungarica.*
AA. Lower valve without a pseudostauros.
  b. Upper valve differing from the lower only in the absence of raphe and nodules.
    c. Apices capitate.
      d. Narrowly lanceolate. 2. *A. microcephala.*
      dd. Gibbous in the middle. 3. *A. biasolettiana.*
    cc. Apices not capitate. 4. *A. linearis.*
  bb. Upper valve with a borseshoe-shaped hyaline space next to one margin in the middle. 5. *A. lanceolata.*

1. **Achnanthes hungarica** Grun. in *Cl. & Grun. Arct. Diat., p. 20. 1880.*

Pl. 13, figs. 483–487; pl. 23, fig. 844.

Narrowly elliptic or linear-lanceolate with ends more or less cuneate or rounded, 15–43 μ long, 6–8 μ wide; upper valve with a narrow axial area, the two middle striations shortened; lower valve with raphe along which is a narrow hyaline space, central striations lacking, leaving a pseudostauros; striations slightly radiate, 18–21 in 10 μ; cells geniculate or, when in longer chains, nearly straight, as in fig. 844.

In creeks, rivers, ditches, ponds, etc., also fossil: Anselmo, Broken

Bow, Brownlee, Cairo, Callaway, Central City, Cody Lake, Columbus, Crawford, Dismal River, Dunning, Emerald, Grand Island, Hackberry Lake, Halsey, Lodi, Louisville, Orella, Pelican Lake, Pleasant Dale, Roca, Ruby, St. Paul, Scottsbluff, Seneca, Stanton, Tekamah, Thedford, Trenton, Valentine.

Fossil: Agate, Cherry County, Mullen, Valentine.

Norris, Rapid City, Rosebud, S. Dak.; Stockton, Cal.

2. **Achnanthes microcephala** (Kütz.) Grun. in *Cl. & Grun. Arct. Diat., p. 22. 1880.*

Achnanthidium microcephalum Kütz. *Bacill., p. 75, pl. 3, figs. 13, 19. 1844.*

Pl. 13, figs. 488–489.

Narrowly lanceolate, 9–26 μ long, 3–4 μ wide; apices capitate; upper valve with parallel striations, all extending to the pseudoraphe except the middle ones, 30–36 in 10 μ; striations of the lower valve slightly radiate, those in the middle much shortened, leaving a transverse hyaline space; cells geniculate, often united in bands.

In creeks, rivers, tanks, etc., also fossil: Andrews, Burge, Grand Island, Hemingford, Long Pine, Scottsbluff, Woodlake.

Fossil: Agate.

Cheyenne, Wyo.; Blackpipe, S. Dak.; Devils Lake, N. Dak.; Fresno, Stockton, Cal.; Emporia, Kansas.

3. **Achnanthes biasolettiana** (Kütz.) Grun. *Arct. Diat., p. 22. 1880.*

Synedra biasolettiana Kütz. *Bacill., p. 63, pl. 3, fig. 22. 1844.*

Pl. 13, figs. 490–491.

Broadly lanceolate, more or less swollen in the middle, 10–20 μ long, 4–6 μ wide; apices broad, rounded, sometimes slightly capitate; striations slightly radiate, 20–25 in 10 μ. Cleve, *Syn. Nav. Diat., II, p. 189*, gives the length 55–31 μ, in which he is followed by Schönfeldt, *Diat. Deutsch., Oest., und Schw., p. 55.* It is likely that Cleve's measurement was intended to be 5.5–31 μ. Van Heurck, *Diat., p. 281*, gives the length about 10 μ, which agrees with both his and Schönfeldt's figures and with the specimens found in Nebraska.

Fossil: Agate.

4. **Achnanthes linearis** (W. Sm.) Grun. *Arct. Diat., p. 23. 1880.*

Achnanthidium lineare W. Sm. *Brit. Diat., II, p. 31, pl. 61, fig. 381. 1856.*

Pl. 13, figs. 492–493.

Linear with rounded ends, 10–20 μ long, 3–4 μ wide; upper valve with narrow, linear axial area and parallel striations; lower valve without axial area and with small transverse central area; striations radiate, 22–28 in 10 μ; cells geniculate.

In Seven Springs at Long Pine.

5. **Achnanthes lanceolata** (Breb.) Grun. *Arct. Diat., p. 23. 1880.*

Achnanthidium lanceolatum Breb. in *Kütz. Spec. Alg., p. 54. 1849.*

Pl. 13, figs. 494–499.

Narrowly elliptic-lanceolate to broadly elliptical, 11–35 μ long, 4–8 μ wide; upper valve with linear central axial area broadened on one side in the middle into a broad horseshoe-shaped hyaline area; striations granular, nearly parallel, 12–16 in 10 μ; lower valve with narrow axial area and broad rectangular central area; striations granular, slightly radiate; cells geniculate.

In creeks, tanks, ponds, lakes, etc.: Andrews, Ashland, Burge, Clear Lake, Dismal River, Dunning, Gordon Creek, Grand Island, Halsey, Long Pine, Louisville, Mason City, Milford, O'Neill, Orella, Orleans, Pleasant Dale, Polk, Red Cloud, Snake River, Tekamah, Thedford, Valentine, Wann, Watts Lake.

Stockton, Cal.; Court Lake, Sully's Hill, N. Dak.; Blackhand, Granville, Ohio.

24. Cocconeis

Cocconeis Ehr. *Inf., p. 193. 1835. em. Grun. Alg. Nov., p. 11. 1868.*

Actinoneis Cleve; *Heteroneis* Cleve.

Etym., from Gr. κόκκος, berry, or grain, on account of its resemblance to a grain of wheat.

Cells single, straight or curved in girdle view and the plane of the upper valve with its margins turned downward; valves round-elliptical to circular, dissimilar, the lower concave with a true raphe

and nodules, the upper with pseudoraphe and no nodules, both transversely punctate-striate; interzones with a narrow marginal fenestrated septum or none; cells living in masses beside but not upon one another, usually epiphytic on other algae. One auxospore is formed asexually from a single cell. The following descriptions of species are taken mostly from Schönfeldt, *Diat. Deutsch., Oest., und Schw.*

A. With a narrow hyaline space in the middle of the valve.
b. With a distinct marginal ring on lower valve. 1. *C. placentula.*
bb. Without distinct marginal ring on lower valve. 2. *C. pediculus.*
AA. With wide hyaline space in the middle of the valve.
3. *C. disculus.*

1. **Cocconeis placentula** Ehr. *Inf., p. 194. 1838.*
Pl. 13, figs. 500–504.

More or less broadly elliptic; upper valve with narrow pseudoraphe, lower valve with distinct raphe not reaching to the ends; striations of the upper valve finely granular, the granules forming undulating longitudinal lines, striations extending to the margins of the valve; lower valve with a distinct broad marginal ring marked with fine granules, striations extending to the marginal ring; length 12–35 μ, width 8–20 μ, striations 15–25 in 10 μ.

Epiphytic on filamentous algae: Andrews, Bellevue, Broken Bow, Callaway, Cedar Creek, Cherry County, Clear Lake, Crawford, Dewey Lake, Dismal River, Dunning, Emmett, Fremont, Grand Island, Hackberry Lake, Holt County, Hyannis, Lodi, Long Lake, Long Pine, New Helena, Newport, Oakdale, Omaha, Pelican Lake, Red Cloud, St. Paul, St. Michael, Scottsbluff, Seneca, Snake River, South Bend, Thedford, Trenton, Valentine, Watts Lake, Whitman, Willow Lake.

Fossil: Greeley County, Hay Springs, Loup City, Merriman, Valentine Belvidere, S. Dak.; Fresno, Cal.; Ft. Collins, Colo.; New Concord, Ohio.

Var. *intermedia* has very coarsely punctate striations on the upper valve, 8–12 in 10 μ.

In river at Seneca.

2. **Cocconeis pediculus** Ehr. *Inf., p. 194, pl. 21, fig. 11. 1838.*
Pl. 13, figs. 505–507.

Elliptical but in form and size extremely variable, long- or broad-elliptical or almost rectangular with rounded corners, some-

times one or both margins bent in at the ends, abnormal forms also occurring; upper surface arched, upper valve with narrow pseudoraphe, lower valve with fine but distinct raphe, distinct terminal and central nodules; striations of the upper valve finely granular, on the margin in the middle often united in twos, slightly radiate, granules of the striations irregular, giving with oblique illumination an undulating appearance; lower valve with narrow area along the raphe, somewhat wider at the central nodule; striations extending almost to the margins of the valve, leaving only a narrow structureless marginal ring; length 15–30 μ, breadth 10–20 μ, striations 17–18 in 10 μ.

C. placentula var. *lineata* Ehr., *Amer., p. 81,* is larger and with striations on the upper valve forming zigzag longitudinal lines. Fig. 506, Valentine, Dewey Lake.

Epiphytic on filamentous algae, very common: Andrews, Ashland, Benkleman, Broken Bow, Burge, Central City, Cody Lake, Columbus, Culbertson, Dewey Lake, Dismal River, Dunning, Fairbury, Fremont, Grand Island, Hackberry Lake, Halsey, Hyannis, Lakeside, Lodi, Long Pine, Louisville, Norfolk, North Platte, Northport, Orleans, Pelican Lake, Ruby, Rupert, St. Paul, Seneca, Stanton, Tioga, Trenton, Valentine, West Point, Wann, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Thedford. Cheyenne, Wyo.; Court Lake, Devils Lake, and fresh water near Devils Lake, N. Dak.; Belvidere, Blackpipe, Little White River, Norris, Rapid City, S. Dak.; Muskingum River, pond on island in Lake Erie, Ohio.

3. **Cocconeis disculus** (Schum.) Cl. in *Cl. & Jentzsch Alluv. Diat. Norddeutsch., p. 129. 1882.*

Navicula disculus Schum. *Preuss. Diat., p. 21, pl. 2, fig. 23. 1864.*

Pl. 13, fig. 508.

Broadly elliptical, 11–20 μ long, 9–15 μ wide; striations 8–13 in 10 μ, composed of coarse dots, shortened, leaving a lanceolate hyaline space; lower valve with very delicate, scarcely visible raphe; striations radiate, consisting of 3 or 4 heavy elongated dots.

In Loup River near Lodi.

25. **Brebissonia** (*Vanheurckia, Frustulia*)

Brebissonia Grun. in *Wien. Verh., p. 512. 1860.*
Vanheurckia Breb. *Ess. Monog. sur le Vanheurckia. 1868.*
Frustulia Grun. *Desm. Diat. Ins. Banka, p. 10. 1865.*
(Not *Frustulia* Ag. *Syst. Alg., p. XIII, 1, 1824.*)
Etym., named for Brebisson.

Cells like *Navicula*, free or very rarely enclosed in gelatinous tubes; striations fine, parallel or slightly radiate in the middle of the valve; raphe enclosed between two siliceous ribs; terminal and central nodules more or less elongated. Striations composed of dots arranged in transverse and longitudinal rows. Chromatophores two plates lying next to the girdle, not changing their position in the cell before division. Auxospore formation; two cells arrange themselves parallel to each other in a mucous mass and form after casting off their shells two cylindrical, transversely striated auxospores which lie parallel to the old valves, the ends of the auxospores forming caps which are later thrown off; valves of the daughter cells formed within the perizonium.

A. Elliptic-lanceolate, central striations radiate. 1. *B. vulgaris.*
AA. Linear-lanceolate, all striations perpendicular 2. *B. interposita.*

1. **Brebissonia vulgaris** (Thwait.) Kuntze. *Rev. Gen. Plant., III, 2, p. 398. 1900.*
Collectonema vulgare Thwait. in *Ann. Nat. Hist., ser. 2, Vol. I, pl. 12.*
Vanheurckia vulgaris (Thwait.) V. H. *Diat., p. 240. 1896.*
Pl. 13, fig. 509.

Elliptical-lanceolate, 44–70 μ long, 11–15 μ wide, apices obtuse, slightly attenuate, central nodule elongated; striations fine, more distant in the center, 24–34 in 10 μ, slightly radiate in the center, nearly perpendicular to the raphe at the ends; cells enclosed in unbranched gelatinous tubes.

In springs, creeks, etc., and on muddy ground: Brock, Dewey Lake, Grand Island, Julian, Lincoln, Mason City, Peru, Seward, Talmage, Tekamah.

Blackhand, Rodney, Ohio.

2. Brebissonia interposita (Lewis) Kuntze. *Rev. Gen. Plant., III, 2, p. 398. 1900.*

Navicula interposita Lewis. *Proc. Acad. Phil., p. 15, pl. 2, fig. 19. 1865.*

Frustulia interposita (Lewis) Cl. *Syn. Nav. Diat., I, p. 123. 1894.*

Pl. 13, figs. 510–511.

Linear-elliptical, 82–130 μ long, 12–27 μ wide, apices rounded; central nodule elongated, terminal nodules round, close to the ends; transverse striations 20–24 in 10 μ, perpendicular to the raphe, longitudinal striations about 18 in 10 μ.

Fossil: Agate.

26. Gyrosigma (*Pleurosigma*)

Gyrosigma Hass. *Brit. Freshw. Alg., p. 435. 1845.*

Pleurosigma W. Sm. in *Ann. Nat. Hist., II, Vol. 9, p. 5. 1853; Achnanthosigma* Reinh.; *Endosigma* Breb.; *Scalprum* Corda; *Staurosigma* Grun.

Etym., from Gr. γῦρος, curve, and σίγμα, the letter *s*, in allusion to the curved form of the cells.

Cells single, free or rarely enclosed in gelatinous tubes; straight and oval-linear in girdle view, sigmoid in valve view; valves bilaterally symmetrical, sigmoid-lanceolate; raphe median, sigmoid; central nodule small; striations crossing in three directions (decussate), or at right angles (rectangular), reaching almost to the raphe. Chromatophores two large widely overlapping plates lying next to the girdle.

A. Striations running in three directions. 1. *G. delicatulum.*

AA. Striations running in two directions.

b. Transverse and longitudinal striations equally distant. 2. *G. acuminatum.*

bb. Transverse striations more distant than longitudinal.

c. Lanceolate.

d. Ends acute. 3. *G. kützingii.*

dd. Ends acuminate. 4. *G. parkerii.*

cc. Linear.

d. Tapering toward the ends. 5. *G. spencerii.*

dd. Ends abruptly and obliquely rounded. 6. *G. scalproides.*

bbb. Longitudinal striations more distant than transverse. 7. *G. attenuatum.*

Gyrosigma delicatulum (W. Sm.) Elmore.

Pleurosigma delicatulum W. Sm. *Ann. Hist., 2d series, vol. 9, p. 6, pl. 1, fig. 5. 1852.*

Pl. 13, figs. 512–513.

Narrow, lanceolate, 139–280 μ long, 14–30 μ wide, apices slightly acute or rounded; raphe nearly central, slightly excentric near the ends; striations crossing in three directions, 18–25 in 10 μ.

In creeks and rivers: Crete, Julian, Lincoln, North Platte

2. **Gyrosigma acuminatum** (Kütz.) Cl. *Syn. Nav. Diat., I, p. 114. 1894.*

Frustulia acuminata Kütz. in *Linnaea, VIII, p. 555. 1833. Syn. Diat., p. 27, fig. 36. 1834.*

Pl. 13, figs. 514–515.

Lanceolate, 100–180 μ long, 10–20 μ wide, tapering toward the rounded ends; raphe central; striations running in two directions, longitudinal and transverse equally distant, 18–20 in 10 μ.

In creeks, rivers, etc.: Ashland, Crete, Julian, Lincoln.
Devils Lake, N. Dak.

3. **Gyrosigma kützingii** (Grun.) Cl. in *Cl. & Grun. Arct. Diat., I, p. 115. 1894.*

Pleurosigma kützingii Grun. *Verh., p. 561, pl. 4, fig. 3. 1860.*

Pl. 13, fig. 516.

Lanceolate, sigmoid, with acute ends, 80–120 μ long, 12–15 μ wide; raphe sigmoid, median; central nodule somewhat elongated; longitudinal striations closer than the transverse; transverse 20–23 in 10 μ, longitudinal 25–26 in 10 μ.

In creeks, rivers, springs, etc.: Central City, Culbertson, Fairbury, Julian, Lincoln, Louisville, Ruby, Stromsburg, Tekamah, Wahoo, Weeping Water.

Devils Lake, N. Dak.; Little White River, Rapid City, Rosebud, S. Dak.; Stockton, Cal.; Muskingum River, New Concord, Ohio.

4. **Gyrosigma parkerii** Harrison in *Q. J. M. S., p. 104. 1860.*

Pl. 13, fig. 517.

Lanceolate, sigmoid, with long acuminate ends, 80–150 μ long, 14–25 μ wide; raphe median except at the ends, where it is ex-

centric; transverse striations 20–23 in 10 μ, longitudinal 24–27 in 10 μ.

In San Joaquin River, Stockton, Cal.

5. **Gyrosigma spencerii** (W. Sm.) Cl. *Syn. Nav. Diat., I, p. 117. 1894.*

Pleurosigma spencerii W. Sm. in *Ann. Nat. Hist., p. 12, pl. 2, fig. 15. 1852.*

Pl. 13, figs. 518–519.

Linear-lanceolate, 58–220 μ long, 10–25 μ wide, tapering toward the rounded ends; transverse striations more distant than the longitudinal; transverse 17–22 in 10 μ, longitudinal 22–24 in 10 μ; raphe sigmoid, median.

In creeks, rivers, ponds, etc.: Brock, Crete, Grand Island, Johnson, Lincoln, Norfolk, Peru, Pleasant Dale, Rulo, St. Michael, Salem, Stromsburg, Talmage, Wahoo, Weeping Water, West Point.

Stockton, Cal.; Emporia, Kansas.

6. **Gyrosigma scalproides** (Rabenh.) Cl. *Syn. Nav. Diat., I, p. 118. 1894.*

Pleurosigma scalproides Rabenh. *Alg. Eu., No. 1101. 1861.*

Pl. 13, fig. 520.

Linear, slightly sigmoid, 57–58 μ long, 9–10 μ wide, apices obliquely rounded; raphe median, nearly straight; central nodule elongated; transverse striations more distant than the longitudinal, transverse about 22 and longitudinal about 29 in 10 μ.

In creeks with *Spirogyra, Oscillatoria,* etc.: Alma, Cook, Grand Island, Lincoln, Norfolk, Orleans, Stanton, Talmage, Weeping Water, West Point.

Stockton, Cal.

7. **Gyrosigma attenuatum** (Kütz.) Cl. *Syn. Nav. Diat., I, p. 115. 1894.*

Frustulia attenuata Kütz. *Dec., No. 83* (according to Lagerst.).

Pl. 23, fig. 857.

Sigmoid, tapering from the middle to the obtuse ends, 180–260 μ long, 25–28 μ wide; raphe central; longitudinal striations 10–12 in 10 μ, transverse striations 14–16 in 10 μ.

Dunning, Norfolk.

Fossil in Pleistocene stratum, Valentine.

27. Amphiprora

Amphiprora Ehr. *Amer., p. 113. 1843; Amphicampa* Rabenh.; *Amphitropis* Pfitz.; *Entomoneis* Ehr.

Etym., from Gr. ἀμφί, both, and πρώρα, the prow of a boat, so called on account of the two-winged margin of the cells.

Cells single, free, twisted, lanceolate in valve view, hour-glass shape in girdle view with a sigmoid girdle; interzones present; valves convex with a raphe concealed in a sigmoid, emarginate keel; central and terminal nodules present; valves transversely striate, rarely scattered-punctate. Chromatophore a single large plate lying next to the girdle.

A. Keel undulate. 1. *A. ornata.*
AA. Keel not undulate. 2. *A. alata.*

1. **Amphiprora ornata** Bailey. *Micro. Obs. in S. C., p. 38, pl. 2, figs. 15, 23. 1850.*

Pl. 14, fig. 521.

Valves membranous, thin, deeply constricted in the middle in girdle view, twisted around the longitudinal axis, 45–80 μ long, 34–50 μ wide; keel undulate; striations radiate, finely granular, 20–22 in 10 μ; connecting zone with 8–10 well-marked plaits.

In Schimmer's Lake, Grand Island.
Stockton, Cal.

2. **Amphiprora alata** (Ehr.) Kütz. *Bacill., p. 107, pl. 3, fig. 63. 1844.*

Navicula alata Ehr. *Ber., p. 18. 1840.*

Pl. 14, figs. 522–525.

Linear-elliptic with apiculate apices, 50–130 μ long, 20–47 μ wide; keel sigmoid, not undulate, furnished with elongated dots, about 4 in 10 μ; striations fine, granular, 11–16 in 10 μ; cells usually twisted around the longitudinal axis, hour-glass shape in girdle view. Fig. 524 shows process of dividing.

In Salt Creek, Lincoln; Little Salt at Arbor; with *Oscillatoria* at Omaha; and at Ashland and Fairbury.

28. Gomphonema.

Gomphonema Ag. *Syst. Alg., p. 15. 1824. Crystallia* Sommerfels; *Dendrella* Bory; *Diomphala* Ehr.; *Gomphonels*

Cleve; *Gomphonella* Rabenh.; *Sphenella* Kütz.; *Sphenosira* Ehr.

Etym., from Gr. γόμφος, wedge, and νήμα, thread, the plant having the appearance of a wedge borne on the end of a thread.

Cells single, mostly stalked, or in gelatinous masses, cuneate in both girdle and valve views; interzones present; valves bilaterally symmetrical, often with one or two constrictions; raphe straight with central and terminal nodules; surface transversely punctate-striate, the striations sometimes lacking opposite the central nodule, giving the appearance of a stauros. Chromatophore one large plate lying next to the girdle. Auxospores two from two mother cells in a common gelatinous envelope.

A. With an isolated dot on one side of the central nodule.
- *b.* Median striations alternately long and short. 1. *G. constrictum.*
- *bb.* Median striations not alternately long and short.
  - *c.* Without stauroneiform area.
    - *d.* Not lanceolate-rostrate.
      - *e.* Upper apex apiculate.
        - *f.* Gibbous in the middle. 2. *G. acuminatum.*
        - *ff.* Not gibbous in the middle. 3. *G. augur.*
      - *ee.* Upper apex not apiculate.
        - *f.* Upper apex broadly rounded.
          - *g.* With rows of dots between the striations. 4. *G. herculeanum.*
          - *gg.* No dots between the striations. 5. *G. eriense.*
        - *ff.* Upper apex not broadly rounded.
          - *g.* Striations coarsely punctate. 6. *G. lanceolatum.*
          - *gg.* Striations not coarsely punctate.
            - *h.* Striations 7 or more in 10 μ; ventral area narrow. 7. *G. montanum.*
            - *hh.* Striations fewer than 7 in 10 μ; ventral area broad. 8. *G. validum.*
    - *dd.* Lanceolate-rostrate.
      - *e.* Middle area round. 9. *G. parvulum.*
      - *ee.* Middle area on one side of the central nodule. 10. *G. angustatum.*
  - *cc.* With stauroneiform area.
    - *d.* At least one end of the valve acute. 11. *G. gracile.*
    - *dd.* Both ends nearly equally obtuse. 12. *G. intricatum.*

AA. No isolated dot.
b. Hyaline area distinct. 13. *G. olivaceum.*
bb. Hyaline area narrow. 14. *G. exiguum.*

1. **Gomphonema constrictum** Ehr. *Abh. Ber. Acad., p. 63. 1830.* (According to Kütz., *Bacill., p. 86.*)

Pl. 14, figs. 526–529.

Cuneate, 37–60 μ long, 7–11 μ wide, inflated in the middle and deeply constricted between the middle and the upper end, which is broadly rounded; striations granular, 10–12 in 10 μ, radiate, alternately long and short around the central nodule; an isolated dot on one side of the central nodule.

In creeks, rivers, etc., also fossil: Andrews, Atkinson, Broken Bow, Burge, Cedar Creek, Central City, Clear Lake, Cody Lake, Crawford, Dewey Lake, Dismal River, Druly Lake, Dunning, Ewing, Fremont, Grand Island, Halsey, Johnson, Lodi, Long Pine, New Helena, Newport, North Platte, Oakdale, Pelican Lake, Rupert, Scottsbluff, Talmage, Tekamah, Thedford, St. Michael, St. Paul, Seneca, Seward, South Bend, Stanton, Thedford, Valentine, Wann, Weeping Water, Willow Lake, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Wheeler County.

Cutmeat, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Ft. Collins, Colo.; Blackhand, Ohio.

2. **Gomphonema acuminatum** Ehr. *Inf., p. 217, No. 308, pl. 18, fig. 4. 1838.*

Pl. 14, figs. 530–534; pl. 23, figs. 845, 847.

Cuneate, 19–70 μ long, 6–12 μ wide, inflated in the middle, constricted below the upper end, which is more or less triangular, apiculate; striations 9–12 in 10 μ, radiate, granular, shortened on one side of the central nodule, leaving a hyaline space in which is an isolated dot. *G. turris* Ehr. is made a variety of *G. acuminatum* by Cleve, *Syn. Nav. Diat., I, 184.*

In springs, creeks, lakes, rivers, etc., with *Spirogyra* and other algae, also fossil: Atkinson, Bellevue, Broken Bow, Central City, Clear Lake, Cody Lake, Dismal River, Dunning, Fremont, Grand Island, Hackberry Lake, Halsey, Hyannis, Lakeside, Long Pine, New Helena, North Platte, Ruby, Scottsbluff, Snake River, Talmage, Tekamah, Thedford, Valentine, Whitman, Woodlake.

Fossil: Agate, Greeley County, Mullen, Thedford, Valentine.

Blackpipe, Cutmeat, Little White River, Rapid City, Turtle River, S. Dak.; Chippewa Falls, Wis.

3. **Gomphonema augur** Ehr. *Abh., p. 17. 1840.*

Pl. 14, fig. 535; pl. 23, fig. 849.

Cordate-cuneate, 30–50 μ long, 9–12 μ wide, upper end obtuse-apiculate, lower end attenuate, slightly rostrate; striations about 10 in 10 μ, granular, radiate, shortened on one side of the central nodule, leaving a clear space in which is an isolated dot.

In rivers, creeks, etc., also fossil: Anselmo, Crawford, Dismal River, Dunning, Gordon Creek, Grand Island, Halsey, Hyannis, Oakdale, Seneca, Stromsburg, Thedford, Trenton, Valentine.

Fossil: Cherry County, Loup City, Spalding, Thedford.

Rosebud, S. Dak.

4. **Gomphonema herculeanum** Ehr. *Ber., p. 78. 1845.*

Pl. 14, fig. 536.

Cuneate at both ends, 38–100 μ long, 12–22 μ wide, upper end broadly rounded, lower end acute, sometimes attenuate; striations granular, alternating with a double row of granules, radiate, 9–10 in 10 μ, shortened in the middle, leaving a rounded hyaline space around the central nodule containing an isolated dot.

Snake River.

Fossil: Mullen.

5. **Gomphonema eriense** Grun. *Alg. Kasp. Meer., p. 109. 1878.*

Pl. 14, figs. 537–538; pl. 23, fig. 848.

Broadly lanceolate, 32–42 μ long, 12–14 μ wide; apex rounded; striations radiate, shortened, leaving a rounded hyaline space around the central nodule with very distinct isolated dot. The specimens from Lake Erie are up to 90 μ long.

With *Lyngbya* in Long Pine Creek, Long Pine; New Helena, St. Paul. Little White River, S. Dak.; pond on island in Lake Erie, Put-in Bay, Ohio.

6. **Gomphonema lanceolatum** Ehr. *Amer., pl. 2, I, 37. 1843.*
Gomphonema lanceolatum Kütz. *Bacill., p. 87, pl. 29, fig. 73. 1844.*

Pl. 14, fig. 539.

Lanceolate, clavate, 27–70 μ long, 10–12 μ wide, gradually tapering from the middle to the obtuse apex and base; striations granular, slightly radiate, 10–13 in 10 μ, shortened at the center, leaving

a rounded hyaline space with an isolated dot. The form called var. *insignis* is the only one yet found in Nebraska.

With *Vaucheria*, Crete.

7. **Gomphonema montanum** Schum. *Diat. Tatra, p. 67, pl. 3, fig. 35b. 1867.*

Gomphonema subclavatum Grun. *Diat. Fr. Jos. Land, p. 46, pl. 1, fig. 13. 1884.*

Pl. 14, figs. 540–553.

Clavate, 10–90 μ long, 5–13 μ wide, sometimes more or less triundulate, apices rounded; striations 7–14 in 10 μ, slightly radiate, 2 or 3 of those on one or both sides of the central nodule shortened, leaving a hyaline space in which is an isolated dot. Very variable in form and size. The varieties *subclavatum* and *commutatum* are probably only forms.

Very common in water everywhere, also fossil: Alma, Andrews, Anselmo, Ashland, Atkinson, Benkleman, Bratton, Brock, Broken Bow, Brownlee, Burge, Callaway, Cedar Creek, Central City, Chadron, Clear Lake, Cody Lake, Columbus, Crawford, Crete, Culbertson, Dewey Lake, Dismal River, Dunning, Emerald, Emmett, Fremont, Grand Island, Hackberry Lake, Halsey, Hemingford, Holbrook, Hyannis, Lakeside, Lincoln, Lodi, Long Lake, Long Pine, Louisville, Mason City, Meadow, Melia, Milford, New Helena, Newport, Norfolk, North Platte, Northport, O'Neill, Orella, Orleans, Pelican Lake, Phalaris Lake, Pleasant Lake, Red Cloud, Ruby, Rupert, St. Michael, St. Paul, Scottsbluff, Seneca, Seward, South Bend, Stanton, Stromsburg, Talmage, Tekamah, Thedford, Tioga, Trenton, Valentine, Wahoo, Wann, Watts Lake, Weeping Water, West Point, Whitman, Willow Lake, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Williams's Canyon.

Belvidere, Blackpipe, Conata, Corn Creek, Cutmeat, Kadoka, Little White River, Norris, Redleaf, Rosebud, S. Dak.; Cheyenne, Wyo.; Devils Lake and fresh water near Devils Lake, N. Dak.; Chippewa Falls, Wis.; Fresno, Cal.; Granville, Ohio; Emporia, Kansas.

8. **Gomphonema validum** Cl. *Syn. Nav. Diat., I, p. 185. 1895.*

Pl. 15, figs. 554–556.

Clavate, regular, or slightly biconstricted; apices rostrate-apiculate, cuneate, or rounded; 65–95 μ long, 7–13 μ wide; striations slightly radiating, 5–7 in 10 μ, shortened, leaving a moderately wide longitudinal hyaline area not dilated in the middle; isolated dot often indistinct.

Pools, rivers, etc.: Grand Island, Hyannis, Norfolk, Thedford.
Fossil: Hay Springs, Loup City, Merriman, Spalding.
Sully's Hill, N. Dak.

9. **Gomphonema parvulum** (Kütz.) Rabenh. *Fl. Eu. Alg., I, p. 291. 1864.*

Sphenella parvula Kütz. *Bacill., p. 83, pl. 30, fig. 63. 1844.*

Pl. 15, figs. 557–561.

Lanceolate-clavate, 19–30 μ long, 6–17 μ wide, apex rounded, rostrate, or capitate; gradually tapering from the middle to the base, which is sometimes slightly capitate; striations 12–14 in 10 μ, nearly transverse, shortened on one side opposite the central nodule, leaving a hyaline space in which is an isolated dot, often indistinct. In the form called var. *micropus*, fig. 561, the striations are more distant, about 8 in 10 μ. Var. *lanceolatum*, fig. 557, is a more lanceolate form.

Common attached to filamentous algae, sticks, stones, etc., also fossil: Ainsworth, Auburn, Broken Bow, Brownlee, Cedar Creek, Cody Lake, Crawford, Dismal River, Dunning, Ewing, Fairbury, Fremont, Glen Rock, Gordon Creek, Grand Island, Hackberry Lake, Hemingford, Holt County, Ithaca, Lincoln, Long Lake, Long Pine, Louisville, Mason City, Minden, New Helena, North Platte, Oakdale, Orella, Orleans, Peru, Pleasant Dale, Polk, Red Cloud, Ruby, St. Michael, Scottsbluff, Seneca, Stanton, Stromsburg, Talmage, Thedford, Valentine, Wahoo, Weeping Water, Whitman, Willow Lake.

Fossil: Agate, Cherry County, Greeley County, Loup City, Mullen, Thedford, Williams's Canyon.

Belvidere, Cutmeat, Kadoka, Rapid City, Rosebud, S. Dak.; Devils Lake, N. Dak.; Cheyenne, Wyo.; Fresno, Cal.; Blackhand, Ohio.

10. **Gomphonema angustatum** (Kütz.) V. H. *Syn., p. 126, pl. 24, figs. 48, 49, 50. 1885.*

Sphenella angustata Kütz. *Bacill., p. 83, pl. 8, fig. 4. 1844.*

Pl. 15, fig. 562.

Cuneate, 30–44 μ long, 7–8 μ wide, nearly symmetrical to the transverse axis, but the upper end somewhat larger, both ends more or less capitate; striations delicate, 8–12 in 10 μ, radiate, shortened on one side of the central nodule; isolated dot indistinct.

In creek, Andrews.

11. **Gomphonema gracile** Ehr. *Inf., p. 217, pl. 18, fig. 3. 1838.*
Pl. 15, figs. 563–566.

Lanceolate or rhomboidal, 25–92 μ long, 7–13 μ wide, apices nearly alike; striations 7–15 in 10 μ, nearly transverse, those in the middle shortened or slightly more distant, leaving a transverse space in which is an isolated dot, often indistinct.

In creeks, rivers, tanks, ponds, lakes, etc., also fossil: Broken Bow, Clear Lake, Cody Lake, Dewey Lake, Dismal River, Dunning, Emerald, Emmett, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Hyannis, Lakeside, Lodi, Mason City, New Helena, Newport, Orella, Orleans, Pleasant Dale, Rupert, Scottsbluff, Seneca, Stromsburg, Thedford, Valentine, Watts Lake, Willow Lake, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Loup City, Mullen, Little White River, Norris. Turtle River, S. Dak.; Stockton, Cal.

12. **Gomphonema intricatum** Kütz. *Bacill., p. 87, pl. 9, fig. 4. 1844.*
Pl. 15, figs. 567–570; pl. 23, fig. 846.

Slender, linear-lanceolate, 21–87 μ long, 4–11 μ wide, more or less swollen in the middle, apices rounded; striations 9–12 in 10 μ, nearly transverse, shortened opposite the central nodule, leaving a rounded space in which is an isolated dot. Very variable in form and size, central area sometimes almost lacking as in fig. 568.

In creeks, ponds, etc., also fossil: Brock, Crawford, Emerald, Grand Island, Red Cloud, Stromsburg, Talmage, Wann, Woodlake.

Fossil: Greeley County.

13. **Gomphonema olivaceum** (Lyngb.) Kütz. *Bacill., p. 85, pl. 7, figs. 13, 15. 1844.*
Echinella olivacea Lyngb. *Tent. Hydr. Dan., p. 209, pl. 70, fig. c, 1–3. 1819.*
Pl. 15, figs. 571–574.

Clavate, rarely sublanceolate, 15–34 μ long, 5–8 μ wide, apex broad and rounded, base narrower; striations 10–14 in 10 μ, usually shortened or lacking in the center, forming a pseudostauros, curved or radiate in the middle, the rest nearly transverse.

Very abundant in creeks, especially in the spring forming brown, gelatinous masses coating stones, sticks, and the bottom of the stream: Antioch, Ashland, Blue Springs, Cairo, Grand Island, Haigler, Lincoln, O'Neill, Seneca, Valentine, Wahoo, Woodlawn.

Corn Creek, S. Dak.; fresh water near Devils Lake, N. Dak.; New Concord, Ohio; Emporia, Kansas.

14. **Gomphonema exiguum** Kütz. *Bacill., p. 84, pl. 30, fig. 58. 1844.*

Pl. 15, figs. 575–576.

Clavate or cuneate, 10–25 μ long, 2–3 μ wide, apex rounded, obtusely angular, or slightly rostrate, base more acute; striations nearly transverse, 15–18 in 10 μ, extending nearly to the raphe and leaving a very narrow hyaline space which is slightly wider opposite the central nodule.

This is a marine species, but Schönfeldt, *Bacill., p. 125,* reports it in fresh water.

In shell marl, Loup City.

29. Rhoicosphenia

Rhoicosphenia Grun. in *Wien. Verh., X, p. 511. 1860.*

Etym., from Gr. ῥοικός, curved, and σφήν, wedge, an appropriate name, the cells being wedge-shape like *Gomphonema*, but curved.

Cells mostly stalked, cuneate in both girdle and valve view, curved in girdle view; interzones present, valves straight, bilaterally symmetrical, transversely striate, unlike, the concave valve with raphe and central and terminal nodules, the convex valve without nodules and with a pseudoraphe. Chromatophores and auxospores as in *Gomphonema.*

Rhoicosphenia curvata (Kütz.) Grun. *Alg. Nov., p. 8. 1867.* *Gomphonema curvatum* Kütz. *Linnaea, X, p. 567, pl. 16, fig. 51. 1833. Syn., p. 39, fig. 51. 1834.*

Pl. 15, figs. 577–581.

Cuneate or spatulate, 15–27 μ long, 3–8 μ wide, upper end rounded or slightly capitate, lower end more acute, but often capitate; upper valve with nearly parallel but slightly radiate striations, 9–10 in 10 μ, reaching to the pseudoraphe, no raphe or nodules; lower valve with striations slightly radiate, 10–14 in 10 μ, extending nearly to the raphe, but slightly shortened opposite the central nodule.

In springs, creeks, rivers, etc., with *Ulothrix, Cladophora,* or other

algae, also fossil: Andrews, Arago, Ashland, Brock, Cedar Creek, Central City, Crawford, Dunning, Grand Island, Haigler, Minden, North Platte, Red Cloud, Ruby, Scottsbluff, Snake River, South Bend, Trenton, Valentine, Wann, Whitman.

Fossil: Thedford.

Belvidere, Blackpipe, Cutmeat, Little White River, Norris, Rapid City, Redleaf, Rosebud, Turtle River, S. Dak.; Devils Lake, N. Dak.; Cheyenne, Wyo.; Ft. Collins, Colo.

30. Cymbella

Cymbella Ag. *Consp., p. 1. 1830. Cymbophora* Breb.; *Gloeodictyon* Ag.; *Gloeonema* Ehr.; *Lunularia* Bory; *Syncyclia* Ehr.

Etym., diminutive of Lat. *cymba,* boat, the same meaning as *Navicula;* but *Cymbella* is the shape of a boat viewed from the side and *Navicula* is the shape of a boat viewed from above.

Cells single, stalked (often becoming free), or enclosed in gelatinous tubes, oblong and straight in girdle view; no interzones; valves lunate, not symmetrical; raphe somewhat excentric, arcuate, rarely straight; central and terminal nodules present; surface transversely striate, without ribs. Chromatophore one large plate the middle of which lies next to the longer girdle side of the cell, the sides reflexed and lying next to both valves and reaching almost to the girdle on the shorter side. In auxospore formation two cells lying parallel with one another surround themselves with a thick gelatinous coating and throw off the valves; the contents of each divides into two, forming four cells, these four cells unite into two, each uniting with a cell from the other mother cell, forming two auxospores.

A. Ventral and dorsal margins bent in opposite directions.
  b. Broadly lanceolate or sub-elliptic.
    c. Apices slightly produced or capitate, axial area wide, large forms. 1. *C. ehrenbergii.*
    cc. Apices rostrate-cuspidate, axial area narrower. 2. *C. cuspidata.*
    ccc. Apices capitate, small forms. 3. *C. amphicephala.*
  bb. More narrowly lanceolate, dorsal margin much more curved than the ventral.
    c. Apices slightly attenuate. 4. *C. pusilla.*
    cc. Apices slightly rostrate or rostrate-capitate.
      d. Ventral margin gibbous. 5. *C. leptoceras.*

dd. Ventral margin not gibbous.
e. Raphe arcuate, striations distant. 6. *C. affinis.*
ee. Raphe nearly straight, striations not so distant. 7. *C. naviculiformis.*
bbb. Naviculoid, ventral margin nearly as convex as the dorsal. 8. *C. aequalis.*
AA. Ventral and dorsal margins bent in the same direction.
b. Terminal nodules not elongated.
c. Striations not interrupted by a broad hyaline space on the ventral side of the valve.
d. Raphe regularly curved toward the dorsal margin.
e. Striations of very coarse dots. 9. *C. gastroides.*
ee. Striations of finer dots.
f. Large forms. 10. *C. lanceolata.*
ff. Small forms. 11. *C. parva.*
dd. Ends of the raphe in the middle of the valve bent toward the ventral side. 12. *C. cymbiformis.*
cc. Striations interrupted by a hyaline space on the ventral side of the central nodule leaving the ends of the striations as isolated dots. 13. *C. cistula.*
bb. Terminal nodules elongated. 14. *C. helvetica.*

1. **Cymbella ehrenbergii** Kütz. *Bacill., p. 79, pl. 6, fig. 11. 1844.*
Navicula inaequalis Ehr. *Inf., pl. 13, fig. 18. 1838.*
Pl. 15, figs. 582, 583, 586, 587.

Elliptic-lanceolate, 90–142 μ long, 28–38 μ wide, apices attenuate or rostrate; ventral margin nearly as convex as the dorsal; raphe nearly straight; striations 5–9 in 10 μ on the dorsal side in the middle, closer elsewhere, slightly shortened, leaving a narrow space along the raphe, more shortened opposite the central nodule, leaving a rounded space. Differs from *C. cuspidata* mainly in size and in the wider space along the raphe.

In creeks and rivers with *Cladophora* and other algae, also fossil: Brownlee, Dismal River, Dunning, Holt County, Seneca, Snake River, St. Michael, Talmage, Thedford, Weeping Water.

Fossil: Cherry County, Greeley County, Hay Springs, Loup City, Mullen, Thedford.

2. **Cymbella cuspidata** Kütz. *Bacill., p. 79, pl. 3, fig. 40. 1844.*
Pl. 15, figs. 584, 585, 588.

Broadly linear-lanceolate, ventral side almost as convex as the

dorsal, 40–95 μ long, 14–24 μ wide, rostrate or rostrate-capitate; raphe nearly straight; striations radiate, 6–10 in 10 μ on the dorsal side in the middle, elsewhere closer, extending nearly to the raphe except opposite the central nodule, where they are shortened, leaving a rounded hyaline space.

Fig. 588 seems to be an abnormal form of *C. cuspidata.*

In creeks, rivers, lakes, etc., also fossil: Bellevue, Dewey Lake, Dismal River, Grand Island, Hackberry Lake, Halsey, New Helena, Pelican Lake, Seneca, Snake River, Wahoo.

Fossil: Agate, Cherry County, Greeley County, Loup City, Mullen, Spalding, Thedford, Valentine, Wheeler County.

Blackpipe, Little White River, Rosebud, S. Dak.; Cheyenne, Wyo.

3. **Cymbella amphicephala** Naeg. in *Kütz. Spec., p. 890. 1849.*

Pl. 16, fig. 589.

Elliptic, 25–40 μ long, 9–10 μ wide, ventral margin convex or nearly straight, ends rostrate or rostrate-capitate; raphe nearly straight, nearer the ventral margin; striations radiate, 10–14 in 10 μ on the dorsal side in the middle, closer elsewhere, finely granular, extending nearly to the raphe, leaving a very narrow space which is slightly wider opposite the central nodule.

In creeks and lakes: Andrews, Clear Lake, Long Pine, Snake River.

In creek at Cheyenne, Wyo.; Rapid City, S. Dak.; Blackhand, New Concord, Put-in Bay, Rodney, Ohio.

4. **Cymbella pusilla** Grun. in *A. Schm. Atlas, pl. 9, figs. 36, 37. 1875.*

Pl. 16, fig. 590.

Lanceolate, 23–40 μ long, 5–9 μ wide, apices acute, often slightly rostrate; raphe straight; striations radiate, 11–18 in 10 μ in the middle on the dorsal side, closer elsewhere, extending nearly to the raphe throughout.

In Pelican Lake.

Devils Lake, N. Dak.; Stockton, Cal.

5. **Cymbella leptoceras** (Ehr.) Rabenh. *Süssw. Diat., pl. 7, fig. 14. 1853. Fl. Eu. Alg., p. 81. 1864.*

Cocconema leptoceras Ehr. *Amer., pl. 1, II, fig. 30. 1843.*

Pl. 16, figs. 591–592.

Dorsal margin evenly curved, ventral nearly straight or slightly

convex, more or less gibbous, 20–56 μ long, 8–12 μ wide; ends obtuse, slightly attenuate; raphe curved toward the dorsal margin; striations nearly perpendicular to the margins, finely granular, 8–11 in 10 μ in the middle on the dorsal side, closer elsewhere, extending nearly to the raphe, leaving a narrow space which is not wider opposite the central nodule, or only slightly so. Van Heurck's figure of *C. leptoceras* var. *elongata, Diat., pl. 1, fig. 33,* closely resembles the form found here.

On muddy banks: Benkleman, Mason City.
Rapid City, S. Dak.

6. **Cymbella affinis** Kütz. *Bacill., p. 80, pl. 6, fig. 15. 1844.*
Pl. 16, fig. 593.

Semi-elliptical or semi-lanceolate, 25–40 μ long, 7–13 μ wide; dorsal margin convex, ventral margin nearly straight, slightly gibbous, ends rounded, sometimes more or less capitate; raphe curved toward the dorsal margin; striations extending nearly to the raphe, not shortened opposite the central nodule except the central one on the ventral side, which is shorter, and in the space which is left by it there is a single dot; striations 9–11 in 10 μ on the dorsal side in the middle, closer elsewhere, finely granular, radiate.

In creeks: Crawford, Meadow.

7. **Cymbella naviculiformis** Auersw. in *Kirch. Alg. Schles., p. 187. 1878.*
Pl. 16, figs. 594–598.

Elliptic-lanceolate, 30–48 μ long, 9–16 μ wide, apices attenuate-rostrate or capitate; raphe nearly straight; striations radiate, 10–14 in 10 μ in the middle on the dorsal side, closer elsewhere, shortened, leaving a narrow space along the raphe, those opposite the central nodule more shortened, leaving a rounded space.

In lakes, creeks, etc.: Andrews, Clear Lake, Dunning, Hackberry Lake, Pelican Lake, Thedford, Whitman.
Weta, S. Dak.

8. **Cymbella aequalis** W. Sm. *Brit. Diat., II, p. 84. 1856.*
Cymbella obtusa Greg. in *Mic. Journ., IV, p. 5, pl. 1, fig. 9. 1855.*
Pl. 16, figs. 599–600.

Elliptic, 30–52 μ long, 11–14 μ wide, dorsal margin more convex than the ventral; ends obtuse, sometimes slightly attenuate; raphe straight or only slightly curved toward the dorsal margin; striations finely granular, 10-14 in 10 μ in the middle on the dorsal side, closer elsewhere, nearly perpendicular to the margins, extending nearly to the raphe, but leaving a distinct space which is slightly wider opposite the central nodule.

In creeks at Andrews and in Clear Lake.

9. **Cymbella gastroides** Kütz. *Bacill., p. 79, pl. 6, fig. 4b. 1844.*
Frustulia gastroides Kütz. *Diat., p. 15, fig. 9. 1834.*
Cocconema asperum Ehr. *Ber. Berl. Akad., p. 12, I, fig. 1. 1840.*
Cymbella aspera (Ehr.) Cl. *Syn. Nav. Diat., I, p. 175. 1894.*
Pl. 16, figs. 601–606.

Broadly lunate, 54–180 μ long, one specimen 244 μ long, 19–37 μ wide, ventral margin slightly concave, usually gibbous; ends obtuse; raphe arcuate with ends bent toward the dorsal margin; striations perpendicular to the margins, 5–9 in 10 μ on the dorsal side in the middle, closer elsewhere, composed of coarse dots, slightly shortened, leaving a distinct space along the raphe which is wider opposite the central nodule. Varies from nearly semicircular to long lunate. Differs from *C. lanceolata* in its usually broader form, striations of coarser dots, and wider space along the raphe. Fig. 606 is of a fossil form found at Thedford.

Common in creeks, rivers, springs, tanks, etc., with *Cladophora, Spirogyra,* or other filamentous algae, also fossil: Andrews, Anselmo, Bellevue, Benkleman, Burge, Callaway, Central City, Crawford, Culbertson, Dismal River, Dunning, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey, Holt County, Lodi, Long Pine, Louisville, Meadow, New Helena, Newport, North Platte, Northport, Oakdale, Orelans, Red Cloud, Ruby, St. Paul, Seneca, Snake River, South Bend, Tekamah, Thedford, Trenton, Valentine, Wann.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Mullen, Spalding, Thedford, Valentine, Williams's Canyon.

Blackpipe, Cutmeat, Little White River, Norris, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Ft. Collins, Colo.; Stockton, Cal.

10. **Cymbella lanceolata** (Ehr.) Kirchn. *Alg. Schles., p. 188. 1878.*
Cocconema lanceolatum Ehr. *Inf., p. 224, pl. 19, fig. 6. 1838.*

Pl. 16, figs. 607–610; pl. 23, fig. 856.

Lunate, 80–218 μ long, 16–32 μ wide, ventral margin slightly concave, usually gibbous in the middle, apices obtuse; raphe arcuate with ends bent toward the dorsal side; striations nearly perpendicular to the margins, 6–10 in 10 μ on the dorsal side in the middle, closer elsewhere, composed of fine dots extending nearly to the raphe, leaving a very narrow space which is slightly wider opposite the central nodule.

In creeks, rivers, ponds, etc., also fossil: Andrews, Broken Bow, Cedar Creek, Chadron, Crawford, Dewey Lake, Dismal River, Grand Island, Hackberry Lake, Halsey, Norfolk, North Platte, Oakdale, St. Michael, Scottsbluff, Seneca, Stanton, Thedford, Valentine, Wann, West Point, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Mullen, Thedford, Valentine, Williams's Canyon.

Stockton, Cal.; Ft. Collins, Colo.; Blackhand, Put-in Bay, Ohio.

11. **Cymbella parva** W. Sm. 1852 according to *Cleve Syn. Nav. Diat., I, p. 172.*

Cocconema parvum W. Sm. *Brit. Diat., I, p. 76, pl. 23, fig. 222, and pl. 24, fig. 222. 1853.*

Pl. 16, figs. 611–612.

Lunate, 30–57 μ long, 9–12 μ wide, ventral margin slightly concave, usually gibbous in the middle, apices obtuse; raphe arcuate with ends bent toward the dorsal side; striations nearly perpendicular to the margins, 8–10 in 10 μ on the dorsal side and 12–13 on the ventral side in the middle, closer toward the ends, extending nearly to the raphe, leaving a very narrow hyaline space which is very slightly larger opposite the central nodule.

Grand Island, Lakeside, New Helena, North Platte, St. Paul, Thedford, Valentine.

Fossil: Hay Springs, Valentine.

Devils Lake and fresh water near Devils Lake, N. Dak.; Cutmeat, Rapid City, S. Dak.

12. **Cymbella cymbiformis** Ag. *Consp., p. 10, 1832.* (According to *Kütz. Syn. Diat., p. 11.*)

Pl. 16, figs. 613–615.

Lunate with nearly straight, sometimes slightly gibbous ventral

margin, 38–100 μ long, 10–14 μ wide; ends obtuse or truncate; raphe slightly curved toward the dorsal margin, its ends bent toward the dorsal side, the ends at the central nodule bent toward the ventral side; striations slightly radiate, finely granular, 7–10 in 10 μ in the middle on the dorsal side, closer elsewhere, extending nearly to the raphe, scarcely shortened opposite the central nodule, the central one or two on the ventral side interrupted, leaving a dot at the end. Fig. 615 is from a specimen in *Rabenh. Alg. Eu., 1168.* The interrupting of the middle striations is not at all constant in Rabenhorst's specimens.

In creeks, etc., also fossil: Grand Island, Mason City.
Fossil: Mullen, Wheeler County.
Cheyenne, Wyo.

13. **Cymbella cistula** (Hempr.) Kirchn. *Alg. Schles., p. 189. 1878.*

Bacillaria cistula Hempr. *Ehr. Symb. Phys. Phyto., pls. II, IV, fig. 10. 1828.*

Pl. 16, figs. 616–620.

Lunate with concave, slightly gibbous ventral margin, 40–68 μ long, 13–15 μ wide (according to *Cleve Syn. Nav. Diat., I, p. 173,* up to 160 μ long and 25 μ wide); raphe arcuate, bent toward the ventral margin near the central nodule, ends bent toward the dorsal side; striations extending nearly to the raphe, 6–9 in 10 μ on the dorsal side in the middle, closer elsewhere; striations interrupted on the ventral side of the central nodule, leaving a row of two to five dots. These dots are mentioned in all descriptions as characteristic of the species and are found in Nebraska specimens, but do not appear in Rabenhorst's specimens, *Alg. Eu., 1028.*

In rivers, ponds, lakes, etc., also fossil: Anselmo, Bellevue, Big Alkali Lake, Broken Bow, Cedar Creek, Crawford, Dewey Lake, Dismal River, Dunning, Gordon Creek, Grand Island, Hackberry Lake, Long Pine, Pelican Lake, St. Paul, Seneca, South Bend, Trenton, Valentine, Wahoo.

Fossil: Agate, Greeley County, Loup City, Merriman, Mullen, Spalding, Thedford, Wheeler County.

Blackpipe, S. Dak.; Devils Lake, N. Dak.; Ft. Collins, Colo.

14. **Cymbella helvetica** Kütz. *Bacill., p. 79, pl. 6, fig. 13. 1844.*
Pl. 16, fig. 621.

Lanceolate with dorsal margin convex, ventral margin slightly concave but swollen in the middle, 36–88 μ long, 10–15 μ wide; raphe nearly straight but slightly curved, the ends at the central nodule bent toward the ventral margin; raphe surrounded by a narrow hyaline space which at the center is widened to about one-third the width of the valve; terminal nodules elongated; striations distinct, 8–9 in 10 μ.

In White River, Andrews.
Fossil: Agate.

31. Encyonema

Encyonema Kütz. *Syn. Diat., p. 61. 1834.*

Etym., from Gr. ἔγκυος, pregnant, and *νήμα*, thread, the cells being connected by a gelatinous mass into threads.

Cells usually enclosed in gelatinous tubes; like *Cymbella* in outline; raphe straight; terminal nodules somewhat distant from the ends. Chromatophores and auxospores as in *Cymbella.*

A. Terminal nodules distant from the ends of the valves.
1. *E. prostratum.*
AA. Terminal nodules nearer the ends of the valves.
b. Striations coarsely granular. 2. *E. turgidum.*
bb. Striations finely granular. 3. *E. ventricosum.*

1. **Encyonema prostratum** (Berk.) Kütz. *Bacill., p. 82, pl. 25, fig. 7. 1844.*
Monema prostratum Berk. *Brit. Alg., pl. 4, fig. 3. 1833.*
Pl. 17, figs. 622–624.

Roughly lunate, 40–100 μ long, 19–30 μ wide, dorsal margin very convex, ventral margin nearly straight, more or less gibbous; apices blunt, usually bent toward the ventral side; raphe straight, not reaching to the ends of the valve; striations radiate, often converging or parallel at the ends, 7–10 in 10 μ, extending nearly to the raphe, those in the middle of unequal length, leaving a wider space. Fig. 624 is drawn from specimen in *Rabenh. Alg. Eu., 1208.*

In springs, creeks, rivers, etc., usually with *Spirogyra* or similar algae:

Culbertson, Dismal River, Dunning, Fairbury, O'Neill, Tekamah, St. Paul, Thedford.

Fossil: Agate, Hay Springs, Loup City, Thedford.

Rapid City, S. Dak.; Ft. Collins, Colo.

2. **Encyonema turgidum** (Greg.) Grun. in *A. Schm. Atl., pl. 10, figs. 40–53. 1874.*

Cymbella turgida Greg. in *Mic. Jour., p. 5, pl. 1, fig. 18. 1856.*

Pl. 17, figs. 625–627.

Lanceolate, 50–100 μ long, 12–23 μ wide, dorsal margin very convex, ventral margin nearly straight or more or less convex, apices acute; raphe straight, about twice as far from the dorsal as from the ventral margin; terminal nodules near the ends; striations nearly perpendicular to the margins or slightly converging at the ends on the ventral side, 7–9 in 10 μ, rather coarsely granular, extending nearly to the raphe, leaving a distinct but narrow space along the raphe, only slightly wider in the center.

In creeks, rivers, lakes, ponds, etc., with *Spirogyra, Vaucheria, Conferva,* or *Oscillatoria,* also fossil: Arago, Ashland, Auburn, Benkleman, Bratton, Brock, Broken Bow, Central City, Culbertson, Dewey Lake, Dismal River, Emerald, Fremont, Grand Island, Long Pine, North Platte, Orleans, Pleasant Dale, Ruby, St. Michael, St. Paul, Scottsbluff, Seneca, Seward, Snake River, South Bend, Talmage, Trenton, Valentine, Wahoo, Weeping Water, West Point, Whitman.

Fossil: Agate, Cherry County, Mullen, Thedford.

Cheyenne, Wyo.; Blackpipe, Rapid City, S. Dak.; Stockton, Cal.; Emporia, Kansas.

3. **Encyonema ventricosum** (Ag.) Grun. in *Kirchn. Alg. Schles., p. 189. 1878.*

Cymbella ventricosa Ag. *Consp., I, p. 9. 1830.*

Encyonema caespitosum Kütz. *Spec. Alg., p. 61. 1849.*

Pl. 17, figs. 628–629.

Naviculoid, 15–36 μ long, 7–12 μ wide, dorsal margin much more convex than the ventral, which is often gibbous; apices slightly acute, often bent toward the ventral side; raphe straight; terminal nodules near the ends of the valves; striations nearly perpendicular to the margins of the valves, 9–16 in 10 μ, extending nearly to the raphe, leaving a very narrow axial area. Fig. 629 is from Rabenhorst's *Alg. Eu., 1636.*

In creeks, rivers, lakes, etc., also fossil: Andrews, Burge, Crawford, Grand Island, Hackberry Lake, Haigler, Long Pine, New Helena, Norfolk, North Platte, Seneca, Thedford, Valentine.

Fossil: Agate, Mullen, Valentine.

Belvidere, Rosebud, Weta, S. Dak.; Cheyenne, Wyo.; Blackhand, Granville, Rio Grande, Ohio.

32. Amphora

Amphora Ehr. in *Ber. Berl. Akad., p. 205. 1840.*

Okedenia Euelenstein.

Etym., *amphora*, a Roman water jar, from a fancied resemblance to this vessel.

Cells single, mostly free, elliptical or rectangular in girdle view, sometimes with cuneate interzones; valves lunate, not symmetrical; raphe excentric, near the concave margin, doubly arcuate; central nodule round or transversely elongated; surface transversely punctate-striate. Chromatophore a single plate lying next to the concave side of the valves and folding back, lining both valves. Auxospores two from two mother cells.

A. Freshwater species.	1. *A. ovalis.*
AA. Salt water species.	
b. Small forms.	2. *A. salina.*
bb. Large forms.	3. *A. proteus.*

1. **Amphora ovalis** Kütz. *Bacill., p. 107, pl. 5, figs. 35, 39. 1844.*
Frustulia ovalis Kütz. *Syn. Diat., p. 11, fig. 5. 1834.*

Pl. 17, figs. 630–643.

Cells oval, 20–84 μ long, 10–16 μ wide, inflated in the middle, apices truncate; valves lunate with acute ends; raphe close to the ventral margin; striations punctate, 8–16 in 10 μ. Very variable and presenting several forms or varieties.

Very common, usually epiphytic on other algae, also fossil: Alma, Andrews, Anselmo, Ashland, Auburn, Bellevue, Benkleman, Big Alkali Lake, Battle Creek, Broken Bow, Brownlee, Burge, Central City, Chadron, Clear Lake, Cody Lake, Crawford, Culbertson, Dewey Lake, Dunning, Emmett, Fairbury, Fremont, Gordon Creek, Grand Island, Halsey, Hackberry Lake, Haigler, Holt County, Humboldt, Hyannis, Lakeside, Lincoln, Little Alkali Lake, Lodi, Long Pine, Milford, New Helena, North Platte, Northport, Oakdale, Omaha, O'Neill, Orella, Orleans, Phalaris Lake, Pleasant Dale, Plattsmouth, Red Cloud, Ruby, Rupert, St. Michael, St. Paul, Salem,

Scottsbluff, Seneca, Sheridan County, Snake River, South Bend, Stanton, Stromsburg, Talmage, Tekamah, Tioga, Thedford, Trenton, Valentine, Wann, Watts Lake, Weeping Water, West Point, Whitman, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Merriman, Mullen, Spalding, Thedford, Valentine, Williams's Canyon.

Belvidere, Blackpipe, Cutmeat, Little White River, Norris, Rapid City, Rosebud, Weta, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Fresno, Stockton, Cal.; Ft. Collins, Colo.; Blackhand, Granville, Put-in Bay, Rio Grande, Ohio; Emporia, Kansas.

2. **Amphora salina** W. Sm. *Brit. Diat., I, p. 19, pl. 30, fig. 251. 1853.*

Pl. 17, fig. 644.

Cells elliptic-oblong with ends slightly attenuate, 21–50 μ long, 3–5 μ wide; valves lunate with rostrate, slightly capitate ends; ventral margin often nearly straight; striations fine, granular, 18–21 in 10 μ.

In basin of salt well and in jar in laboratory, Lincoln.

3. **Amphora proteus** Greg. *Diat. of Clyde, p. 518, pl. 13, fig. 81. 1857.*

Pl. 17, fig. 645.

Cells elliptic with truncate ends, 70–150 μ long, 40–60 μ wide; valves lunate, ends obtuse; raphe bent, central nodule large, often surrounded by a stauroneiform space; striations very distinct, granular, 8–10 in 10 μ.

In Devils Lake, N. Dak.

33. Cystopleura

Cystopleura Breb. in *Kütz. Spec. Alg., p. 3. 1849.*

Epithemia Breb.; *Amphicampa* Ehr.; *Climacidium* Ehr.; *Desmogonium* Ehr.

Etym., from Gr. κύστις, vesicle, and πλευρά, rib, a name probably suggested by the clear vesicle-like appearance of the cell with the very prominent ribs.

Cells single, rarely in short chains, attached ventrally to other plants, girdle view oblong to barrel-shaped. Interzones present or absent; valves lunate, internally transversely ribbed, transversely beaded externally; raphe excentric, near the concave margin.

Chromatophores usually one or two large plates. Auxospores two from two conjugating mother cells.

A. Striations twice as numerous as the costae.
- *b.* Valves arcuate.
  - *c.* Striations coarsely granular. 1. *C. turgida.*
  - *cc.* Striations finely granular. 2. *C. sorex.*
- *bb.* Valves nearly straight.
  - *c.* Elongated, slightly gibbous. 3. *C. gibba.*
  - *cc.* Shorter, strongly gibbous. 4. *C. ventricosa.*

AA. Striations at least four times as numerous as the costae.
- *b.* Costae scarcely radiate, striations coarsely granular.
  - *c.* Costae with apices capitate in girdle view.
    - *d.* Costae close. 5. *C. ocellata.*
    - *dd.* Costae distant. 6. *C. argus.*
  - *cc.* Costae with apices not capitate in girdle view. 7. *C. zebra.*
- *bb.* Costae radiate, striations finely granular.
  - *c.* Ventral margin nearly straight. 8. *C. gibberula.*
  - *cc.* Ventral margin curved. 9. *C. musculus.*

1. **Cystopleura turgida** (Ehr.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Navicula turgida Ehr. *Abh., p. 64. 1830.*

Epithemia turgida (Ehr.) Kütz. *Bacill., p. 34, pl. 5, fig. 14. 1844.*

Pl. 17, figs. 646–648.

Arcuate, 70–195 μ long, dorsal margin more curved than the ventral, ends more or less capitate; costae distinct, perpendicular to the margins, 3.5–4 in 10 μ; striations coarsely granular, 7–8 in 10 μ. Very variable, hence presenting many so-called varieties. Fig. 647 agrees with var. *vertagus.*

Very common in ponds, rivers, creeks, tanks, etc., attached to filamentous algae, also fossil: Anselmo, Battle Creek, Bellevue, Brownlee, Burge, Callaway, Cedar Creek, Central City, Cody Lake, Crawford, Culbertson, Dismal River, Dunning, Johnson, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey, Hyannis, Holt County, Lakeside, Lodi, Long Pine, Nebraska City, New Helena, Newport, North Platte, Northport, Oakdale, Orleans, Peru, Phalaris Lake, Ruby, Rupert, St. Michael, St. Paul, Scottsbluff, Seneca, Snake River, South Bend, Stromsburg, Talmage, Tekamah, Thedford, Tioga, Valentine, Wahoo, Wann, Whitman.

Fossil: Agate, Cherry County, Greeley County, Loup City, Merriman, Mullen, Thedford, Valentine, Wheeler County.

Blackpipe, Cutmeat, Little White River, Norris, Rapid City, Redleaf, Rosebud, S. Dak.; Court Lake, fresh water near Devils Lake, N. Dak.; Stockton, Cal.; Blackhand, Ohio.

2. **Cystopleura sorex** (Kütz.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Epithemia sorex Kütz. *Bacill., p. 33, pl. 5, fig. XII, 5. 1844.*

Pl. 17, figs. 649–652.

Valves strongly arcuate, 24–40 μ long, 8–10 μ wide; ends usually capitate, sometimes only slightly so; costae distinct, radiate, 6–7 in 10 μ; striations granular, 12–14 in 10 μ; cells in girdle view long-oval, broadened in the middle.

In creeks, rivers, ponds, etc., also fossil: Cedar Creek, Peru, Rulo, St. Paul, Scottsbluff, Seneca, Valentine.

Fossil: Thedford.

Belvidere, Little White River, S. Dak.; Devils Lake, N. Dak.; Ft. Collins, Colo.

3. **Cystopleura gibba** (Ehr.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Navicula gibba Ehr. *Abh. 1830.*

Epithemia gibba (Ehr.) Kütz. *Bacill., p. 35, pl. 4, fig. 22. 1844.*

Pl. 17, figs. 653–654.

Linear, slightly curved, 85–200 μ long, 21–23 μ wide; dorsal margin slightly convex, somewhat inflated in the middle; ventral margin nearly straight; costae parallel, 6–8 in 10 μ; striations granular, 12–14 in 10 μ.

Very common in creeks, tanks, rivers, etc., with various algae or with diatoms only, also fossil: Anselmo, Benkleman, Big Alkali Lake, Brownlee, Burge, Central City, Clear Lake, Cody Lake, Crawford, Culbertson, Dismal River, Dunning, Fremont, Grand Island, Hackberry Lake, Haigler, Holt County, Humboldt, Ithaca, Lakeside, Long Pine, Meadow, North Platte, Oakdale, Orella, Orleans, Phalaris Lake, Ruby, Rupert, Scottsbluff, Seneca, St. Michael, St. Paul, Stanton, Talmage, Thedford, Valentine, Wahoo, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Loup City, Merriman, Mullen, Thedford, Valentine, Wheeler County.

Belvidere, Blackpipe, Cutmeat, Dallas, Imlay, Little White River, Norris, Rapid City, Rosebud, Turtle River, S. Dak.; Court Lake, Devils Lake,

fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Ft. Collins, Colo.; Muskingum River, Rio Grande, Ohio.

4. **Cystopleura ventricosa** (Kütz.) Elmore.

Epithemia ventricosa Kütz. *Bacill., p. 35, pl. 30, fig. 9. 1844.*

Pl. 17, figs. 655–657.

Elliptical, 37–75 μ long, 19–22 μ wide in girdle view, gibbous in the middle; ventral side straight or nearly so with ends more or less produced toward the ventral side; costae heavy, nearly parallel in the center, becoming more radiate toward the ends, 5.5–7 in 10 μ; striations granular, 12–14 in 10 μ. Often described as a variety of *C. gibba*, from which it differs mainly in size and in the larger inflation in the middle.

Very common in almost all places where any diatoms can grow, also fossil: Ainsworth, Anselmo, Arago, Ashland, Bellevue, Broken Bow, Brownlee, Burge, Callaway, Cedar Creek, Cherry County, Clear Lake, Crawford, Dismal River, Dunning, Emerald, Ewing, Fremont, Georgetown, Gordon Creek, Grand Island, Halsey, Holt County, Humboldt, Hyannis, Lakeside, Lodi, Long Pine, Louisville, Meadow, New Helena, Norfolk, Peru, Plattsmouth, Pleasant Dale, Red Cloud, Ruby, Rulo, St. Paul, Scottsbluff, Seneca, Snake River, South Bend, Tecumseh, Tekamah, Thedford, Valentine, Wann, West Point, Whitman, Woodlake.

Fossil: Cherry County, Mullen, Thedford.

Dallas, Rosebud, Turtle River, Weta, S. Dak.; Devils Lake, N. Dak.; Cheyenne, Wyo.

5. **Cystopleura ocellata** (Ehr.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Eunotia ocellata Ehr. *Ber., p. 15. 1840.*

Epithemia ocellata Kütz. *Bacill., p. 34, pl. 29, fig. 57. 1844.*

Pl. 17, figs. 658–660.

Valves lunate, 25–32 μ long, 5–6 μ wide; ends bluntly rounded or sometimes acute; costae heavy, 3–4 in 10 μ, capitate in girdle view; striations granular, 12–20 in 10 μ.

In creeks, lakes, rivers, etc., also fossil: Anselmo, Benkleman, Brownlee, Burge, Crawford, Culbertson, Dismal River, Dunning, Emmett, Grand Island, Hackberry Lake, Haigler, Halsey, Lakeside, Long Pine, New Helena, North Platte, Red Cloud, Rupert, St. Michael, St. Paul, Scottsbluff, Seneca, Snake River, Stanton, Tioga, Valentine.

Fossil: Agate, Loup City, Mullen, Thedford.

Little White River, Rosebud, S. Dak.; Cheyenne, Wyo.; fresh water near Devils Lake, N. Dak.; Stockton, Cal.

6. **Cystopleura argus** (Kütz.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Epithemia argus Kütz. *Bacill., pl. 29, fig. 55. 1844.*

Pl. 17, fig. 661; pl. 23, figs. 850–855.

Dorsal margin slightly arcuate, ventral margin nearly straight, 40–70 μ long, apices obtuse; costae slightly radiate with capitate apices, 1–2 in 10 μ; striations granular, 10–14 in 10 μ.

Lakeside, Woodlake.
Fossil: Hay Springs, Merriman.
Fresh water near Devils Lake, N. Dak.

7. **Cystopleura zebra** (Ehr.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Navicula zebra Ehr. *Abh., p. 262. 1833.*

Epithemia zebra (Ehr.) Kütz. *Bacill., p. 34, pl. 5, fig. 12; pl. 30, fig. 5. 1844.*

Pl. 17, figs. 662–667.

Curved, 35–70 μ long, 8–12 μ wide; dorsal margin strongly convex, ventral more or less concave; apices somewhat capitate; pseudoraphe distinct, incurved, forming an angle at the center; costae heavy, 3–4 in 10 μ; striations coarsely granular, 12–14 in 10 μ. Var. *proboscidea* is a more curved form.

In creeks, rivers, ponds, etc., also fossil: Benkleman, Burge, Clear Lake, Crawford, Dismal River, Dunning, Gibbon, Grand Island, Halsey, Holt County, Hyannis, Lakeside, St. Paul, Seneca, Snake River, South Bend, Talmage, Thedford, Trenton, Valentine, Wann.

Fossil: Agate, Cherry County, Hay Springs, Loup City, Merriman, Mullen, Thedford.

Blackpipe, Cutmeat, Norris, S. Dak.; Court Lake, Devils Lake, N. Dak.; Ft. Collins, Colo.; Stockton, Cal.

8. **Cystopleura gibberula** (Kütz.) Kuntze. *Rev. Gen. Plant., II, p. 891. 1891.*

Epithemia gibberula Kütz. *Bacill., p. 35, pl. 29, fig. 54; pl. 30, fig. 3. 1844.*

Pl. 17, figs. 668–669.

Valves strongly lunate, 20–70 μ long; dorsal margin very strongly curved, ventral margin nearly straight, gradually tapering

toward the acute ends; costae 3–4 in 10 μ, radiate; striations granular, about 16 in 10 μ; in girdle view broadly elliptical to lanceolate-elliptical. Var. *producta* Grun. is a smaller form with ends of valves attenuate.

In creeks, etc.: Crawford, Fremont, Grand Island, Norfolk, Valentine, Woodlake.

Fossil: Hay Springs.

9. **Cystopleura musculus** (Kütz.) Kuntze. *Rev. Gen. Plant., II. p. 891. 1891.*

Epithemia musculus Kütz. *Bacill., p. 33, pl. 30, fig. 6. 1844.* Pl. 17, figs. 670–671.

Valves nearly semicircular, 27–50 μ long, 7–9 μ wide; dorsal margin strongly convex, ventral margin concave; ends acute and somewhat produced; costae radiate, about 4 in 10 μ; striations granular, about 16 in 10 μ; in girdle view broadly elliptical.

In creeks, lakes, ponds, etc., also fossil: Anselmo, Ashland, Clear Lake, Crawford, Emerald, Fremont, Grand Island, Lakeside, New Helena, Orleans, Pleasant Dale, Ruby, Rupert, Scottsbluff, Stanton, Talmage, Thedford, Trenton, Valentine.

Fossil: Cherry County.

Blackpipe, Little White River, Turtle River, S. Dak.; Cheyenne, Wyo.

Family 7. BACILLARIACEAE

Cells usually very much broader than long (rod-like), usually free-swimming, but some enclosed in gelatinous tubes and a few adhering in filaments. Rachis lateral, hence not interrupting the fine striations; containing an elongated slit.

34. **Homoeocladia** (*Nitzschia*)

Homoeocladia Ag. *Flora, II, p. 629. 1827.*

Etym., from Gr. ὅμοιος, similar, and κλάδος, branch, from the fact that some of the species to which the name was first given grow in branching tubes of uniform diameter.

Nitzschia Hassall. *Brit. Freshw. Algae, p. 435. 1845. Grunowia* Rabenh.; *Oscillaria* Schrank.; *Pritchardia* Rabenh.; *Sigmatella* Kütz.

Cells mostly free, rarely in tubes or chains, sometimes stalked; elongated or linear, rhombic in cross-section; valves linear to lanceolate or elliptical, pointed, with the oblique, bordered keel at

one edge enclosing the raphe; keels of the two valves on the opposite sides of the cell except in the subdivision *Hantzschia*, where they are on the same side; surface punctate-striate, usually transversely, decussate in some species. Chromatophore one large plate with an entire or partial fissure and with one or many small pyrenoids lying next to the girdle side.

TABLE OF GROUPS

A. Not long-rostrate.
b. Keels of the two valves on the same side of the cell.
1. *Hantzschia*, page 132.
bb. Keels of the two valves diagonally opposite.
c. Valves undulate. 2. *Tryblionella*, page 133.
cc. Valves not undulate.
d. With costae extending partly across the valves or carinal dots prolonged into delicate costae.
3. *Grunowia*, page 134.
dd. Carinal dots not prolonged into costae.
e. Cells more or less sigmoid.
f. Keel straight, not inflected in the middle.
g. Keel almost central; girdle face with apices not attenuate. 4. *Sigmoideae*, page 135.
gg. Keel excentric; girdle face with apices slightly attenuate. 5. *Sigmata*, page 137.
ff. Keel excentric; inflected in the middle.
6. *Obtusae*, page 137.
ee. Cells not sigmoid.
f. Cells arcuate. 7. *Spectabiles*, page 138.
ff. Cells not arcuate.
g. Girdle face constricted in the middle.
8. *Dubiae*, page 138.
gg. Girdle face not constricted in the middle.
h. Valves showing a longitudinal sulcus in which the striations are either absent or indistinct. 9. *Apiculatae*, page 139.
hh. No longitudinal sulcus.
i. Keel excentric.
10. *Lanceolatae*, page 140.
ii. Keel not entirely excentric.
j. Keel almost central; striations very distinct. cells united in a plate.
11. *Bacillaria*, page 143.
jj. Keel somewhat excentric; cells not united.

k. Valves linear, large, striations distinct. 12. *Lineares,* page 143.

kk. Valves lanceolate, small, striations indistinct. 13. *Dissipatae,* page 144.

AA. Valves long-rostrate with very excentric keel. 14. *Nitschiella,* page 145.

AAA. Cells in a gelatinous tube. 15. *Homoeocladia,* page 145.

1. Hantzschia

A. Carinal dots not elongated. 1. *H. amphioxys.*

AA. Carinal dots elongated. 2. *H. virgata.*

1. **Homoeocladia amphioxys** (Ehr.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Hantzschia amphioxys (Ehr.) Grun. in *Cl. & Grun. Arct. Diat., p. 103. 1880.*

Eunotia amphioxys Ehr. *Amer., p. 125. 1843.*

Pl. 18, figs. 672–680.

More or less curved, 34–192 μ long, 10–18 μ wide; apices more or less rostrate; carina marginal with 4–7 round dots in 10 μ, the two central dots slightly more separated, carinae of the two valves on the same side of the cell, fig. 680; striations granular, 10–15 in 10 μ. Very variable and presenting several forms called varieties. Var. *major,* figs. 672, 674; var. *elongata,* fig. 673; var. *vivax,* figs. 675, 679.

Very common under all conditions where any diatoms can grow; creeks, springs, ponds, rivers, tanks, stagnant ditches, etc., also fossil: Ainsworth, Anselmo, Benkleman, Brock, Broken Bow, Brownlee, Burge, Central City, Cherry County, Clear Lake, Columbus, Crawford, Culbertson, Dismal River, Dunning, Emerald, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey, Hemingford, Holbrook, Holt County, Hyannis, Ithaca, Lakeside, Lincoln, Lodi, Long Pine, Louisville, Milford, New Helena, Norfolk, North Platte, Oakdale, O'Neill, Orella, Orleans, Pelican Lake, Peru, Pleasant Dale, Red Cloud, Ruby, Rupert, St. Libory, St. Michael, St. Paul, Seneca, Seward, Sheridan, County, Snake River, Stanton, Talmage, Tekamah, Thedford, Trenton, Valentine, Wann, Watts Lake, Weeping Water, West Point, Whitman, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Loup City, Mullen, Thedford, Valentine, Wheeler County.

Belvidere, Blackpipe, Imlay, Interior, Little White River, Norris, Redleaf, Rosebud, Scenic, Turtle River, Weta, S. Dak.; Devils Lake, fresh water near Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.; New Concord, Rio Grande, Ohio.

2. **Homoeocladia virgata** (Roper) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Hantzschia virgata (Roper) Grun. in *Cl. & Grun. Arct. Diat., p. 104. 1880.*

Nitzschia virgata Roper in *Mic. Jour., VI, p. 23. 1858.*

Pl. 18, fig. 681.

Robust, arcuate, 66–130 μ long, 13–20 μ wide, apices strongly rostrate, obtuse, keels of the two valves on the same side of the cell, with elongated dots, 4–5 in 10 μ, the two central dots slightly more separated; striations 9–11 in 10 μ.

In pond, Orella.

2. Tryblionella

A. Striations composed of coarse puncta. — 3. *H. punctata.*
AA. Striations not of coarse puncta.
b. Striations extending across the entire valve. — 4. *H. angustata.*
bb. Striations interrupted by a sulcus. — 5. *H. tryblionella.*

3. **Homoeocladia punctata** (W. Sm.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia punctata (W. Sm.) Grun. in *Cl. & Grun. Arct. Diat., p. 68. 1880.*

Tryblionella punctata W. Sm. *Brit. Diat., I, p. 36, pl. 30, fig. 261. 1853.*

Pl. 18, figs. 682–686.

Elliptical to elliptical-lanceolate, 25–40 μ long, 7–30 μ wide, apices acute or acuminate; keel marginal with the dots corresponding with the striations, which are formed of coarse dots, 7–10 in 10 μ.

Ponds: Pleasant Dale, Grand Island.
Fossil: Thedford.

4. **Homoeocladia angustata** (W. Sm.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Nitzschia angustata (W. Sm.) Grun. in *Cl. & Grun. Arct. Diat., p. 70. 1880.*

Tryblionella angustata W. Sm. *Brit. Diat., I, p. 36, pl. 30, fig. 262. 1853.*

Pl. 18, figs. 687–691.

Narrowly linear to ovate-lanceolate, 80–90 μ long, about 10 μ wide, apices attenuate; keel marginal, dots corresponding with the striations, about 13 in 10 μ. The form described as var. *curta* is smaller, 48–67 μ long, 7–11 μ wide.

In creeks, ponds, etc.: Culbertson, Fremont, Grand Island, Norfolk, North Platte, Ruby, Trenton, West Point.

5. **Homoeocladia tryblionella** (Hantz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia tryblionella Hantz. in *Rabenh. Alg., No. 984. 1871.*

Pl. 18, figs. 692–698.

From elliptical to lanceolate, 20–110 μ long, 6–30 μ wide, apices more or less acute; valves undulate with a sulcus making the striations appear broken; keel marginal with indistinct dots elongated to form costae or striations, 7–12 in 10 μ, very fine punctate striations mixed with the coarser striations. Var. *levidensis* is a form more elongated and with finer striations, fig. 693. Very variable. Grunow in *Cl. & Grun. Arct. Diat., p. 69,* says: "This widely distributed species includes a very large number of forms among which it is very difficult to separate a single variety with certainty as is here attempted. They vary in respect to form, length, and width, the undulation of the valves, the distinct or indistinct punctation of the very variable striations which sometimes are very much fainter in the middle than near the margins and sometimes equally distinct over the entire valve. Many valves appear strongly costate and many punctate with only indistinct striations."

Common among higher algae where conditions are good: Alma, Arbor, Ashland, Auburn, Blue Springs, Cherry County, Crawford, Culbertson, Fairbury, Fremont, Grand Island, Hackberry Lake, Lincoln, Nemaha City, North Platte, Omaha, Orleans, Pleasant Dale, Ruby, Rupert, St. Paul, Stanton, Stromsburg, Talmage, Tekamah, Wahoo, Wann, Weeping Water.

Belvidere, Rapid City, Rosebud, S. Dak.; Court Lake, Devils Lake, fresh water near Devils Lake, N. Dak.; Stockton, Cal.

3. Grunowia

A. Valves with sinuous margins. 6. *H. tabellaria.*

AA. Margins of valves not sinuous. 7. *H. obtusa.*

6. **Homoeocladia tabellaria** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Denticula tabellaria Grun. in *Wien. Verh., p. 548. 1862.*

Nitzschia tabellaria Grun. in *Cl. & Grun. Arct. Diat., p. 82. 1880.*

Nitzschia sinuata (W. Sm.) Grun. in *Cl. & Grun. Arct. Diat., p. 82. 1880.*

Denticula sinuata W. Sm. *Brit. Diat., II, p. 21. 1856.*

Pl. 18, fig. 699.

Lanceolate with margins undulate, very much inflated in the middle, 26–30 μ long, 7–10 μ wide, apices small, globose; keel marginal with dots elongated into costae extending about to the middle of the valve, 5–6 in 10 μ; striations 18–20 in 10 μ. The specimen represented in fig. 699 seems intermediate between *Nitzschia sinuata* (W. Sm.) Grun. and *Nitzschia sinuata* var. *tabellaria* Grun. as figured in *V. H. Diat., pl. 15, figs. 516, 517.*

Fossil in limestone: Mullen.

7. **Homoeocladia obtusa** (Lyngb.) Elmore.

Echinella obtusa Lyngb. *Hydrophyt. Dan., pl. 69. 1819.*

Frustulia obtusa Ag. *Consp., p. 44. 1830.*

Nitzschia denticula Grun. in *Cl. & M. Diat. Exsic., No. 224. 1878.*

Pl. 18, figs. 700–706.

Narrowly lanceolate, 14–86 μ long, 6–9 μ wide, apices more or less acute, not rostrate; keel marginal with dots elongated into costae which extend from half across the valve to entirely across, 4–8 in 10 μ; striations granular, 14–18 in 10 μ.

In tanks, rivers, creeks, etc.: Crawford, Long Pine, Louisville, North Platte, O'Neill, Rupert, Seneca, Stromsburg, Valentine.

Fossil: Agate.

Cheyenne, Wyo.; Blackpipe, S. Dak.; Stockton, Cal.

4. Sigmoideae

A. Striations distinct; carinal dots round. 8. *H. brebissonii.*

AA. Striations fine; carinal dots somewhat elongated.

b. Very large; dots 4–7 in 10 μ. 9. *H. sigmoidea.*

bb. Medium size; dots 7–9 in 10 μ. 10. *H vermicularis.*

8. **Homoeocladia brebissonii** (W. Sm.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Nitzschia brebissonii W. Sm. *Brit. Diat., I, p. 38, pl. 31, fig. 266. 1853.*

Pl. 18, fig. 710.

Straight, arcuate, or sigmoid, 220–345 μ long, 12–15 μ wide, apices attenuate, sometimes capitate; keel central with coarse dots, 4–5 in 10 μ; striations 9–11 in 10 μ.

Clear Lake, Grand Island, St. Paul, Snake River.
Fossil: Agate.

9. **Homoeocladia sigmoidea** (Nitz.) Elmore.

Nitzschia sigmoidea (Nitz.) W. Sm. *Brit. Diat., I, p. 38. 1853.*

Bacillaria sigmoidea Nitz. *Beitr., p. 104. 1817.*

Pl. 18, figs. 708–709.

Linear or lanceolate with cuneate apices, 100–480 μ long; keel nearly central with rounded dots, 4–8 in 10 μ; striations 24–30 in 10 μ; girdle face sigmoid, linear, or somewhat lanceolate with truncate apices.

In ponds, creeks, etc.: Grand Island, Lincoln, Orella.
New Concord, Ohio.

10. **Homoeocladia vermicularis** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia vermicularis (Kütz.) Hantz. in *Rabenh. Alg., No. 899.*

Synedra vermicularis Kütz. *Bacill., p. 67, pl. 4, fig. 35. 1844.*

Pl. 19, figs. 713–716.

Linear or linear-lanceolate, straight or slightly sigmoid, apices attenuate, sometimes capitate, 90–220 μ long, 4–11 μ wide; keel nearly central with slightly elongated dots, 6–10 in 10 μ; striations very delicate, 30–34 in 10 μ.

In ditches, creeks, springs, etc., also fossil: Alma, Andrews, Arago, Auburn, Blue Springs, Brock, Brownville, Clear Lake, Crawford, Crete, Culbertson, Fairbury, Glen Rock, Grand Island, Holbrook, Johnson, Julian, Lincoln, Mason City, Minden, Nemaha City, New Helena, Norfolk, Omaha, Orleans, Peru, Ruby, Rulo, Salem, Stanton, Stromsburg, Talmage, Valentine, Weeping Water.

Fossil: Mullen.

Belvidere, Rapid City, Rosebud, S. Dak.; Devils Lake, N. Dak.; Stockton, Cal.; New Concord, Ohio; Emporia, Kansas.

5. Sigmata

A. Keel with coarse projecting dots. 11. *H. fasciculata.*
AA. Keel with rather delicate dots. 12. *H. sigma.*

11. **Homoeocladia fasciculata** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia fasciculata Grun. *Alg. Kasp. Meer, p. 119. 1878.*

Pl. 19, fig. 717.

More or less sigmoid, 67–95 μ long, 6–7 μ wide; keel excentric with 4–6 dots in 10 μ, dots somewhat elongated; striations 28–30 in 10 μ; girdle face sigmoid.

Pleasant Dale.

12. **Homoeocladia sigma** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia sigma (Kütz.) W. Sm. *Brit. Diat., I, p. 39. 1853.*

Synedra sigma Kütz. *Bacill., p. 67, pl. 30, fig. 14. 1844.*

Pl. 19, figs. 718–724.

Linear, slightly sigmoid, 88–250 μ long, 5–11 μ wide; keel somewhat excentric with 7–9 dots in 10 μ; striations 22–30 in 10 μ; girdle face sigmoid with tapering apices. Variable and presenting many forms represented by var. *rigidula*, figs. 722–723; var. *rigida*, fig. 721. Very much sigmoid in var. *intercedens*, fig. 720.

In creeks, springs, ponds, etc., with *Spirogyra* and other algae: Ashland, Auburn, Dunning, Emerald, Fairbury, Grand Island, Hyannis, Julian, Lincoln, Milford, North Platte, Oakdale, Orella, Sheridan County, Stanton, Stromsburg, Tekamah, Trenton, Valentine, Wahoo.

Belvidere, Cutmeat, S. Dak.; Stockton, Cal.

6. Obtusae

13. **Homoeocladia arcus** (Buhln.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia arcus Buhln. in *Hedwigia, II, p. 22, pl. 2, fig. 1. 1859.*

Nitzschia obtusa W. Sm. *Brit. Diat., I, p. 39, pl. 13, fig. 109. 1853.*

Pl. 23, fig. 861.

Linear, 120–300 μ long, slightly sigmoid, obtusely rounded at both ends; keel more or less excentric with 5–6 dots in 10 μ; striations 26–27 in 10 μ. No specimen yet found in Nebraska attains this size. Represented here by var. *brevissima,* which is short-linear, slightly curved and constricted in the middle, 27–28 μ long, 5–6 μ wide, with 8–10 dots and about 30 striations in 10 μ; apices apiculate.

Damp ground, tanks, creeks, etc.: Ainsworth, Anselmo, Dunning, Ewing, Grand Island, Lakeside, Long Pine, Louisville, Stromsburg, Valentine, West Point.

7. Spectabiles

14. **Homoeocladia spectabilis** (Ehr.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia spectabilis (Ehr.) Ralfs in *Pritch. Inf., p. 782. 1843.*

Synedra spectabilis Ehr. *Verb. (figures only). 1843.*

Pl. 19, figs. 711–712.

Linear, slightly curved, 160–306 μ long, 11–15 μ wide, apices cuneate, attenuate, often rostrate; keel marginal with large dots sometimes slightly prolonged, 3–7 in 10 μ; striations 11–15 in 10 μ.

In lakes, creeks, rivers, also fossil: Ainsworth, Anselmo, Clear Lake, Dunning, Emmett, Hackberry Lake, Halsey, Long Pine, Newport, O'Neil[l], St. Michael, St. Paul, Thedford, Whitman.

Fossil: Agate, Cherry County, Hay Springs, Merriman, Mullen, Spalding.

Little White River, S. Dak.; fresh water near Devils Lake, N. Dak.; Stockton, Cal.

8. Dubiae

A. Carinal dots elongated; valves broad. — 15. *H. dubia.*

AA. Carinal dots round; valves elongated.

b. Small, striations fine, distinctly rostrate. — 16. *H. commutata.*

bb. Medium size, sub-rostrate. — 17. *H. umbonata.*

15. **Homoeocladia dubia** (W. Sm.) Elmore.

Nitzschia dubia W. Sm. *Brit. Diat., I, p. 41, pl. 13, fig. 112.*

Pl. 19, fig. 725.

Linear, ventral side nearly straight, dorsal side slightly convex, slightly constricted in the middle, 90–160 μ long, about 15 μ wide,

apices rounded or sub-rostrate; carinal dots slightly elongated, 9–10 in 10 μ; striations fine, 20–24 in 10 μ.

In ditch by railroad: Culbertson.

16. **Homoeocladia commutata** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Nitzschia commutata Grun. in *Cl. & Grun. Arct. Diat., p. 79. 1880.*

Pl. 19, figs. 726–728; pl. 23, fig. 858.

Linear, 34–73 μ long, 8–17 μ wide, constricted in the middle, apices attenuate-rostrate; keel marginal with round dots, 8–10 in 10 μ, the two middle ones more distant; striations 21–24 in 10 μ.

In ponds and creeks: Anselmo, Grand Island, Lincoln, Trenton. Devils Lake and fresh water near Devils Lake, N. Dak.

17. **Homoeocladia umbonata** (Ehr.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Navicula umbonata Ehr. *Abh., p. 36. 1836.*

Nitzschia thermalis (Ehr.) Auersw. in *Rabenh. Alg., Nos. 1064 and 1266.*

Pl. 19, fig. 729.

Linear-lanceolate or oblong, 80–100 μ long, 9–10 μ wide, slightly constricted in the middle, making the cell somewhat curved, apices cuneate; keel marginal with round dots, 7–8 in 10 μ; striations about 28 in 10 μ.

Talmage.

9. Apiculatae

A. Keel with very distinct dots. 18. *H. hungarica.*
AA. Keel with indistinct dots. 19. *H. apiculata.*

18. **Homoeocladia hungarica** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia hungarica Grun. in *Wien. Verh., p. 568, pl. 22, fig. 13. 1862.*

Pl. 19, figs. 730–735.

Linear, usually constricted in the middle, 48–110 μ long, 8–11 μ wide, apices slightly acuminate, acute or truncate; keel marginal with 7–11 dots in 10 μ; striations 15–20 in 10 μ, interrupted through the middle by a longitudinal sulcus.

In creeks, springs, tanks, ponds, etc.; in brackish water at Arbor: Arbor, Ashland, Auburn, Blue Springs, Cedar Creek, Culbertson, Fairbury, Grand Island, Hyannis, Lincoln, Louisville, Oakdale, Omaha, Orleans, Ruby, Salem, Scottsbluff, Seneca, Seward, Stromsburg, Talmage, Trenton, Wann. Belvidere, Little White River, Norris, Rapid City, Rosebud, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Stockton, Cal.

19. **Homoeocladia apiculata** (Greg.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Nitzschia apiculata (Greg.) Grun. in *Cl. & Grun. Arct. Diat., p. 73. 1880.*

Tryblionella apiculata Greg. in *Mic. Jour., V, p. 79, pl. 1, fig. 3.*

Pl. 19, fig. 736.

Linear, more or less constricted in the middle and below the apices, 25–34 μ long, 6–8 μ wide, apices apiculate, sometimes truncate; keel marginal with no visible dots; striations broken by the narrow sulcus, 15–19 in 10 μ.

In jar in laboratory, Lincoln; roadside ditch, Grand Island; North Platte, Scottsbluff.

10. Lanceolatae

A, Connecting zone very broad and plicate. 20. *H. lanceolata.*
AA. Connecting zone narrow.
b. Middle carinal dots more distant than the others.
c. Striations 30–32 in 10 μ. 21. *H. subtilis.*
cc. Striations about 24 in 10 μ. 22. *H. intermedia.*
bb. Carinal dots all equidistant.
c. Striations distinct, 16–17 in 10 μ. 23. *H. amphibia.*
cc. Striations indistinct, more than 20 in 10 μ.
d. Lanceolate, striations very delicate, 30–36 in 10 μ. 24. *H. palea.*
dd. Narrowly lanceolate, striations more easily seen, 20–22 in 10 μ. 25. *H. frustulum.*

20. **Homoeocladia lanceolata** (W. Sm.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia lanceolata W. Sm. *Brit. Diat., I, p. 40, pl. 14, fig. 118. 1853.*

Pl. 19, figs. 737–739.

Narrowly lanceolate, 66–200 μ long, 8–17.5 μ wide, apices acute, sometimes attenuate and rostrate; keel marginal with rounded dots,

5–8 in 10 μ, the middle ones not separated more than the others; striations 24–30 in 10 μ.

Grand Island, Valentine.
Devils Lake, N. Dak.; Emporia, Kansas.

21. **Homoeocladia subtilis** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*
Nitzschia subtilis Grun. in *Cl. & Grun. Arct. Diat., p. 95. 1880.*
Pl. 20, fig. 740.

Narrowly lanceolate, 49–120 μ long, 4.5–9 μ wide, apices attenuate; keel marginal with dots not elongated, 7–13 in 10 μ, the two middle dots more distant than the rest; striations 30–32 in 10 μ; girdle face straight. The form described as var. *paleacea* is smaller and more delicate with 12–14 dots in 10 μ.

In creeks, ponds, pools, etc.: Arago, Brock, Grand Island, Humboldt, Johnson, Julian, Lincoln, Louisville, Oakdale, Orleans, Peru, Pleasant Dale, Seneca, Talmage, Weeping Water.
Kadoka, S. Dak.; Put-in Bay, Ohio.

22. **Homoeocladia intermedia** (Hantz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*
Nitzschia intermedia Hantz. in *Cl. & Grun. Arct. Diat., p. 95. 1880.*
Pl. 20, figs. 741–742.

Linear, slightly lanceolate, 68–100 μ long, apices attenuate, slightly rostrate; keel somewhat excentric with 8–9 dots in 10 μ; striations about 24 in 10 μ.

With *Oscillatoria* in springs, marshes, watering troughs, stagnant pools, etc.: Dawson, Long Pine, Peru, Salem.
Fossil: Loup City.

23. **Homoeocladia amphibia** (Grun.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*
Nitzschia amphibia Grun. in *Wien. Verh., p. 574. 1862.*
Pl. 20, figs. 743–751.

Linear or ovate-lanceolate, usually attenuate, apices usually rounded, sometimes slightly capitate, 14–60 μ long, 3.3–8 μ wide; keel marginal with round dots, 6–8 in 10 μ; striations distinct, 12–17 in 10 μ; cells sometimes united in bands like *Fragilaria*.

Very common in tanks, creeks, springs, ponds, etc., usually with some of the higher algae. Filamentous forms were found in jar in laboratory in Lincoln and in Blue River at Seward: Andrews, Anselmo, Ashland, Auburn, Battle Creek, Benkleman, Brock, Broken Bow, Brownlee, Burge, Callaway, Central City, Chadron, Clear Lake, Cody Lake, Crawford, Culbertson, Dismal River, Dunning, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Humboldt, Hyannis, Lakeside, Lodi, Long Pine, Louisville, Melia, Newport, North Platte, Northport, O'Neill, Orella, Orleans, Phalaris Lake, Pleasant Dale, Polk, Red Cloud, Ruby, Rupert, St. Deroin, St. Michael, St. Paul, Scottsbluff, Seneca, Snake River, Stanton, Stromsburg, Talmage, Tioga, Trenton, Valentine, Wann, Weeping Water, West Point, Whitman, Woodlake.

Fossil: Agate, Cherry County, Greeley County, Hay Springs, Mullen, Spalding, Thedford, Valentine.

Cutmeat, Dallas, Kadoka, Little White River, Norris, Rosebud, Weta, S. Dak.; Court Lake, and fresh water near Devils Lake, N. Dak.; Fresno, Cal.; Ft. Collins, Colo.; New Concord, Put-in Bay, Ohio.

24. **Homoeocladia palea** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia palea (Kütz.) W. Sm. *Brit. Diat., II, p. 89. 1856.*

Synedra palea Kütz. *Bacill., p. 63, pl. 3, fig. 27. 1844.*

Pl. 20, figs. 752–757.

Linear or linear-lanceolate, apices acute, attenuate or often rostrate, 22–66 μ long, 2.5–5.5 μ wide; keel marginal with fine dots, 10–12 in 10 μ, the middle dots not separated; striations very faint, 33–36 in 10 μ. Very variable. The form represented by var. *tenuirostris*, figs. 752–753, is common.

Very common especially in stock tanks, ditches, etc., usually with blue-green algae, also fossil: Ainsworth, Alma, Andrews, Anselmo, Antioch, Ashland, Aspinwall, Atkinson, Battle Creek, Bellevue, Benkleman, Brock, Broken Bow, Brownlee, Cairo, Callaway, Cedar Creek, Central City, Cherry County, Clear Lake, Columbus, Cook, Crawford, Crete, Culbertson, Dawson, Dewey Lake, Dunning, Emerald, Fairbury, Fremont, Gibbon, Gordon Creek, Grand Island, Hackberry Lake, Haigler, Halsey Hemingford, Holbrook, Humboldt, Hyannis, Ithaca, Johnson, Lakeside, Lincoln, Long Pine, Mason City, Milford, New Helena, Niobrara River in Holt County, Norfolk, North Platte, Oakland, Omaha, O'Neill, Pawnee City, Pelican Lake, Peru, Red Cloud, Ruby, Rupert, St. Deroin, St. Libory, St. Michael, St. Paul, Salem, Seneca, Sheridan County, Snake River, Stromsburg, Talmage, Tecumseh, Tekamah, Thedford, Trenton, Valentine, Wahoo, Weeping Water, West Point.

Fossil: Hay Springs.

Belvidere, Corn Creek, Little White River, Rapid City, Redleaf, Scenic, Weta, S. Dak.; Devils Lake and fresh water near Devils Lake, N. Dak.; Stockton, Cal.; Blackhand, Muskingum River, Ohio.

25. **Homoeocladia frustulum** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia frustulum (Kütz.) Grun. in *Cl. & Grun. Arct. Diat., p. 98. 1880.*

Synedra frustulum Kütz. *Bacill., p. 63, pl. 30, fig. 77. 1844.*

Pl. 20, figs. 758–760.

Linear or ovate-lanceolate, usually attenuate, sometimes slightly capitate, 18–40 μ long, 4–7 μ wide; keel marginal with round dots, 9–12 in 10 μ; striations distinct, 20–24 in 10 μ. The form described as var. *perpusilla* is found, fig. 759.

Ponds, creeks, etc.: Burge, Dismal River, Grand Island, Lincoln.

11. Bacillaria

26. **Homoeocladia paxillifer** (Müller) Elmore.

Vibrio paxillifer Müller. *Inf., p. 54, pl. 7, figs. 3–7. 1786.*

Bacillaria paradoxa Gmel. in *Linn. Syst. Nat., ed. 12, VI. 1788.*

Nitzschia paradoxa (Gmel.) Grun. in *Cleve & Grun. Arct. Diat., p. 85. 1880.*

Pl. 20, figs. 761–763.

Linear, 60–158 μ long, 3–6 μ wide, apices attenuate, slightly rostrate; carina nearly central with 6–8 round dots in 10 μ; striations 17–24 in 10 μ. Cells united in a stratum and moving back and forth longitudinally past one another (fig. 761).

In fresh and brackish water: Crete, Lincoln, Louisville, North Platte. Fresh water near Devils Lake, N. Dak.; Stockton, Cal.; Emporia, Kansas.

12. Lineares

A. 8–12 faint carinal dots in 10 μ; valve with slight inflection in the middle. *27. H. linearis.*

AA. 5–7 distinct carinal dots in 10 μ; no median inflection. *28. H. vitrea.*

27. **Homoeocladia linearis** (Ag.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia linearis (Ag.) W. Sm. *Brit. Diat., I, p. 39, pl. 13, fig. 110. 1853.*

Frustulia linearis Ag. *"ex spec. authen. quae misit Dr. Greville," W. Sm., l.c.*

Pl. 20, figs. 764–765; pl. 23, fig. 859.

Linear, 70–180 μ long, 5–6 μ wide, sometimes with a constriction in the middle, apices attenuate, rostrate or capitate; keel somewhat excentric with 8–12 dots in 10 μ; striations indistinct, 22–24 in 10 μ. The form represented by var. *tenuis*, fig. 765, resembles the type, but is smaller and has finer striations, about 30 in 10 μ.

In creeks with *Oscillatoria, Spirogyra, Vaucheria,* etc.: Andrews, Fairbury, Grand Island, Humboldt, Lincoln, Talmage, Wahoo, Weeping Water.

Fresno, Cal.

28. **Homoeocladia vitrea** (Norm.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia vitrea Norm. in *Jour. Mic. Soc., IX, p. 7. 1861.*

Pl. 20, figs. 766–768.

Linear-lanceolate, often tapering more on one margin than the other, 50–130 μ long; keel somewhat excentric with large square or rounded dots, 5–8 in 10 μ; striations 20–22 in 10 μ. The form described as var. *recta* is smaller and more linear with more rounded apices and finer striations, fig. 768.

In creeks and ponds with *Spirogyra or Hormiscia*: Arago, Auburn, Fairbury, Orella, Peru, Scottsbluff, Talmage, Whitman.

Fresh water near Devils Lake, N. Dak.

13. Dissipatae

29. **Homoeocladia dissipata** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 409. 1898.*

Nitzschia dissipata (Kütz.) Grun. in *Cl. & Grun. Arct. Diat., p. 90. 1880.*

Synedra dissipata Kütz. *Bacill., p. 64, pl. 14, fig. 3. 1844.*

Pl. 20, figs. 769–771.

Lanceolate, 20–45 μ long, about 5 μ wide, apices attenuate, slightly rostrate; keel somewhat excentric with 6–8 dots in 10 μ; striations not distinct. Van Heurck, *Diat., p. 394,* quotes Kitton as authority for there being 14 in 10 μ.

In creek, Long Pine.

14. Nitzschiella

30. **Homoeocladia acicularis** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 408. 1898.*

Nitzschia acicularis (Kütz.) W. Sm. *Brit. Diat., I, p. 43, pl. 15, fig. 122. 1853.*

Synedra acicularis Kütz. *Bacill., p. 63, pl. 4, fig. 3. 1844.*

Pl. 20, figs. 772–774.

Lanceolate, 50–85 μ long, apices attenuated into a long rostrum the length of which is very variable; keel marginal with small dots, 12–18 in 10 μ; striations not easily visible, but according to W. Sm., l.c., there are 40 in 10 μ.

Common especially with *Oscillatoria* and other blue-green algae. In salt marsh at Arbor: Arago, Arbor, Ashland, Auburn, Blue Springs, Brock, Burge, Cherry County, Fairbury, Grand Island, Humboldt, Julian, Lincoln, Rulo, Salem, Seneca, Talmage, Weeping Water.

Stockton, Cal.; Emporia, Kansas.

15. Homoeocladia

31. **Homoeocladia filiformis** W. Sm. *Brit. Diat., II, p. 80, pl. 55, fig. 348. 1856.*

Pl. 20, figs. 775–777.

Cells in groups of 2–4 enclosed in simple gelatinous filaments. Valves linear or lanceolate with apices more or less acute, 49–100 μ long, 4–6 μ wide; keel central with 5–7 dots in 10 μ; striations fine.

In creek, Fairbury.

Family 8. SURIRELLACEAE

Cells free-swimming, symmetrical to the longitudinal axis, oval, elliptic, or nearly circular, in girdle view straight, spirally twisted, undulate, or saddle-shaped. Rachis a narrow, unmarked strip; valves with two lateral wing-keels, each enclosing a slit.

35. **Sphinctocystis** (*Cymatopleura*)

Sphinctocystis Hass. *Brit. Freshw. Alg., p. 436, pl. 102, fig. 3. 1845.*

Cymatopleura W. Sm. in *Ann. and Mag. Nat. Hist., p. 133. 1851.*

Etym., from Gr. σφιγγείν, to bind, and κύστις, cell, the species to which the name was first applied being constricted in the middle.

Cells free, oblong to linear, straight; valve surface undulate and transversely striate with a beaded keel on each margin containing the raphe; a straight pseudoraphe along the center of the valve. Chromatophores two plates lying next to the valves. Auxospore one from two cells.

A. Broadly elliptical or elliptic-lanceolate. 1. *S. elliptica.*
AA. Linear with apices usually rostrate. 2. *S. librilis.*

1. **Sphinctocystis elliptica** (Kütz.) Kuntze. *Rev. Gen. Plant., III, p. 431. 1898.*
Cymatopleura elliptica (Kütz.) W. Sm. in *Ann. and Mag. Nat. Hist., p. 133. 1851.*
Surirella elliptica Kütz. *Bacill., p. 61, pl. 28, fig. 28. 1844.*
Pl. 20, fig. 778.

Elliptical or elliptical-lanceolate, sometimes slightly constricted in the middle, 70–140 μ long, marginal costae short, resembling beads, 3–4 in 10 μ; striations delicate, about 18 in 10 μ; valves undulate, showing 4 or 5 depressions. The spiral form mentioned by Wolle, *Diat. of N. A., pl. 108, fig. 6,* occurs quite commonly mixed with the normal form and is evidently only an abnormal form of it. It is found also in fossil material from Mullen.

In creeks, rivers, ponds, springs, etc., usually where conditions are especially favorable for algae, also fossil: Broken Bow, Callaway, Central City, Crawford, Fremont, Grand Island, Julian, Nemaha City, New Helena, North Platte, Orleans, Plattsmouth, Ruby, St. Paul, Seneca, Talmage, Thedford, Valentine, Wann, Weeping Water.

Fossil: Hay Springs, Mullen, Valentine.

Blackpipe, Little White River, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Emporia, Kansas.

2. **Sphinctocystis librilis** (Ehr.) Hass. *Brit. Freshw. Alg., p. 436, pl. 102, fig. 3. 1845.*
Navicula librilis Ehr. *Inf., p. 185. 1838.*
Cymatopleura solea (Breb.) W. Sm. in *Ann. and Mag. Nat. Hist., p. 12, pl. 3, fig. 9. 1851.*
Surirella solea Breb. *Consid., p. 17. 1838.*

Frustulia quinquepunctata Kütz. in *Linnaea, p. 554. 1833.*
Pl. 20, figs. 779–784.

Oblong, more or less constricted in the middle, 39–169 μ long (according to De Toni, *Syll. Alg., II, p. 599,* 300 μ long), 14–31 μ wide, apices rounded or slightly apiculate; marginal beads about 8 in 10 μ; striations perpendicular to the margins, 8–9 in 10 μ, indistinct or lacking in from 2 to 4 spots in the middle of the valve; valves undulate, as is clearly seen in girdle view. Very variable, showing all gradations from the short form in fig. 780 to the long one in fig. 779.

In creeks, rivers, ponds, pools, etc., also fossil: Andrews, Anselmo, Ashland, Blue Springs, Brock, Cairo, Callaway, Crawford, Crete, Culbertson, Dismal River, Dunning, Emerald, Fairbury, Fremont, Gordon Creek, Grand Island, Johnson, Lincoln, Long Pine, Nemaha City, New Helena, Norfolk, North Platte, Oakdale, Orleans, Plattsmouth, Rulo, St. Paul, Seneca, Snake River, South Bend, Stanton, Stromsburg, Talmage, Thedford, Valentine, Wahoo, Wann, Weeping Water.

Fossil: Greeley County, Hay Springs, Loup City, Mullen, Spalding, Valentine.

Blackpipe, Little White River, Rapid City, Rosebud, S. Dak.; Devils Lake, N. Dak.; Cheyenne, Wyo.; Stockton, Cal.; Ft. Collins, Colo.; Blackhand, Muskingum River, New Concord, Ohio; Emporia, Kansas.

36. Surirella

Surirella Turpin. *Mem. Mus., p. 362, tab. 16. 1828.*
Novilla Heib. *Consp. Diat. Dan., p. 100. 1863. Stenopterobia* Breb.; *Suriraya* Pfitzer in *De Toni Syll. Alg., II, p. 567. 1891.*

Etym., named for Doctor Suriray of Havre, France.

Cells free or stalked, straight or twisted, in valve view cuneate, reniform, ovate, elliptical, or linear; girdle view cuneate, elliptical, oblong, or sigmoid; valves with beaded or ribbed keel on each margin containing the raphe; surface with the ribs extending from the margin toward or to the median linear or lanceolate pseudoraphe. Chromatophores and auxospores as in *Sphinctocystis.*

A. Valves usually plane.
b. Costae extending to or nearly to the median line.
c. The two apices alike.
d. Small, linear-elliptic. 1. *S. linearis.*
dd. Large, lanceolate. 2. *S. biseriata.*

cc. Ovate.
d. Costae extending to the median line.
e. Long-oval. 3. *S. saxonica.*
ee. Broadly oval. 4. *S. striatula.*
dd. Costae shortened leaving a clear space along the median line.
e. Costae heavy. 5. *S. robusta.*
ee. Costae delicate. 6. *S. elegans.*
bb. Costae marginal, valves sometimes twisted. 7. *S. ovalis.*
AA. Valves twisted into the form of a figure "8." 8. *S. spiralis.*

1. **Surirella linearis** W. Sm. *Brit. Diat., I, p. 31, pl. 8, fig. 58. 1853.*

Pl. 21, figs. 785–788.

Oblong or linear, 16–46 μ long, 8–9 μ wide, sometimes somewhat constricted in the middle, apices cuneate; costae 3–7 in 10 μ, marginal or extending almost to the pseudoraphe. The costae in this species are described as 2–3.5 in 10 μ, but otherwise specimens from Nebraska agree with the type.

Common in tanks, springs, rivers, etc.: Alma, Andrews, Arago, Ashland, Auburn, Benkleman, Blue Springs, Brock, Broken Bow, Brownlee, Cairo, Central City, Columbus, Cook, Crawford, Culbertson, Dismal River, Fairbury, Gordon Creek, Grand Island, Hackberry Lake, Lincoln, Lodi, Long Pine, Louisville, Mason City, Milford, New Helena, O'Neill, Orleans, Phalaris Lake, Ruby, St. Michael, St. Paul, Salem, Seneca, Stromsburg, Talmage, Tekamah, Thedford, Valentine, Weeping Water, West Point, York.

Belvidere, Blackpipe, Rosebud, S. Dak.; Cheyenne, Wyo.; Chippewa Falls, Wis.; Blackhand, New Concord, Rio Grande, Rodney, Ohio.

2. **Surirella biseriata** Breb. *Alg. Falaise, pl. 7. 1838.*

Pl. 21, fig. 789.

Lanceolate to elliptical, 96–170 μ long, 25–52 μ wide, apices sometimes slightly rostrate; costae very heavy, 1.75–2 in 10 μ, somewhat radiate; var. *elliptica* is a form more elliptical and smaller than the type, some specimens only 39 μ long.

In creeks, etc.: Andrews, Crawford, Oakdale, Tekamah.
Fossil: Greeley County.
Little White River, Rosebud, S. Dak.; Stockton, Cal.

3. **Surirella saxonica** Auersw. in *Rabenh. Alg. 1421.*
Pl. 21, figs. 790–792.

Long-ovate, 75–200 μ long, 25–38 μ wide; costae 1.5–3 in 10 μ, extending to the distinct pseudoraphe; striations indistinct; dried empty shells often brownish. Differs from *S. robusta* mainly in the more distinct pseudoraphe with costae extending to it.

In springs and creeks, also fossil: Aspinwall, Brock, Brownville, Fairbury, Long Pine, New Helena, Talmage, Thedford, Wahoo, Weeping Water, West Point.

Fossil: Agate.

4. **Surirella striatula** Turp. in *Mem. du Mus. d'Hist. Nat., XVI. 1828.*
Pl. 21, fig. 793.

Broadly oval, sometimes spirally twisted, 95–160 μ long, about 75 μ wide; costae robust, about 1 in 10 μ, reaching to the median line; striations 14–15 in 10 μ; girdle face cuneate, showing marginal alae.

Devils Lake and fresh water near Devils Lake, N. Dak.

5. **Surirella robusta** Ehr. in *Ber. Berl. Akad., p. 215. 1840.*
Pl. 21, fig. 794.

Long-ovate, 135–365 μ long; pseudoraphe broad, alae distinct; costae very distinct, 1.5–2 in 10 μ, reaching nearly to the pseudoraphe, nearly perpendicular to the margins; striations indistinct, 10–14 in 10 μ. Var. *splendida* is a form somewhat smaller.

Common among luxuriantly growing algae in creeks, rivers, ponds, etc., also fossil: Alma, Anselmo, Burge, Cherry County, Crawford, Culbertson, Dismal River, Dunning, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Halsey, Lakeside, Long Pine, Norfolk, North Platte, Oakdale, Orleans, Red Cloud, St. Paul, Seneca, Snake River, Stanton, Stromsburg, Talmage, Tekamah, Thedford, Valentine, Weeping Water.

Fossil: Greeley County, Mullen, Spalding, Valentine.

Blackpipe, Little White River, Rapid City, Rosebud, S. Dak.; Blackhand, Ohio.

6. **Surirella elegans** Ehr. *Verb., p. 136, pl. III, 1, fig. 22. 1843.*
Pl. 23, fig. 860.

Oval, 180–240 μ long, 60–76 μ wide; costae delicate, 1.5–2 in

10 μ, extending nearly to the pseudoraphe; striations indistinct, about 22 in 10 μ.

In ditch, Thedford.

7. **Surirella ovalis** Breb. *Consid. 1838.* (According to *Kütz. Bacill., p. 61.*)

Pl. 21, figs. 795–806.

Ovate-elliptical or broadly ovate, sometimes subcordate, 27–80 μ long, 9–24 μ wide; costae short, marginal, perpendicular to the margin, 5–6 in 10 μ; striations very delicate, about 18 in 10 μ; pseudoraphe narrow. Very variable, most of the specimens found agreeing with the form called var. *ovata.* This form is often twisted like *S. spiralis,* as in figs. 799, 801. Var. *minuta* is a very small form, 12–25 μ long. Fig. 806 is a form found in Devils Lake, N. Dak.

Common among luxuriantly growing algae: Alma, Andrews, Anselmo, Arago, Ashland, Auburn, Benkleman, Blue Springs, Brock, Broken Bow, Brownlee, Central City, Clear Lake, Cook, Crawford, Culbertson, Dismal River, Emerald, Fairbury, Fremont, Gordon Creek, Grand Island, Hackberry Lake, Julian, Lakeside, Lincoln, Lodi, Louisville, Mason City, New Helena, Norfolk, North Platte, Omaha, Orleans, Ruby, Rupert, St. Paul, Salem, Seneca, Seward, Stanton, Stromsburg, Talmage, Tekamah, Thedford, Trenton, Valentine, Wahoo, Wann, Weeping Water, York.

Blackpipe, Rapid City, Rosebud, S. Dak.; Cheyenne, Wyo.; Chippewa Falls, Wis.; Ft. Collins, Colo.; Blackhand, New Concord, Rodney, Ohio.

8. **Surirella spiralis** Kütz. *Bacill., p. 60, pl. 3, fig. 64. 1844.*

Pl. 21, fig. 807.

Elliptical-lanceolate, 95–150 μ long, 40–50 μ wide, twisted around the longitudinal axis, resembling the figure "8"; costae 2–3 in 10 μ, extending nearly to the center.

In creeks, rivers, ponds, etc., also fossil: Anselmo, Callaway, Dismal River, Snake River, Valentine.

Fossil: Agate, Mullen.

Rosebud, Turtle River, S. Dak.

37. Campylodiscus

Campylodiscus Ehr. in *Ber. Berl. Akad., p. 11. 1840.*

Calcodiscus Rabenh.; *Coronia* Ehr.

Etym., from Gr. καμπύλος, curved, and δίσκος, disk, so named from the cells being nearly circular and curved.

Cells solitary, free, disk-shaped, disk twisted or saddle-shaped; valves round-elliptic with short, mostly radiate ribs and a marginal keel concealing the raphe; pseudoraphe median, but at right angles in the two valves. Chromatophores as in *Sphinctocystis*.

A. Central space with coarse dots.
  b. Valves bent. 1. *C. clypeus*.
  bb. Valves very much bent. 2. *C. hibernicus*.
AA. Dots lacking in the central space which is somewhat rectangular. 3. *C. bicostatus*.

1. **Campylodiscus clypeus** Ehr. *Abh., p. 201. 1840.*

Pl. 21, fig. 808.

Nearly circular, 85–200 μ in diameter, saddle-shaped; costae reaching about half way to the center, about 1.5 in 10 μ; striations among the costae, 20–21 in 10 μ, consisting of elongated dots; central portion of the valve filled with coarse dots irregularly or radially arranged.

Typically a marine species: Big Alkali Lake; pool by lake, Lakeside. Devils Lake, N. Dak.

2. **Campylodiscus hibernicus** Ehr. *Ber. Berl. Akad., p. 154. 1845.*

Pl. 21, fig. 809.

Nearly circular, 90–100 μ in diameter, very much bent; costae 1.5–2 in 10 μ, very heavy near the margin, tapering toward the center, where they leave a nearly square punctate space.

In Rapid Creek at Rapid City, S. Dak.

3. **Campylodiscus bicostatus** W. Sm. *Brit. Diat., II, p. 88. 1856.*

Pl. 21, fig. 810.

Nearly circular, 30–50 μ in diameter, with narrow costae the spaces between which are punctate; central space somewhat rectangular with rounded angles, the center of which has no dots.

With *Cladophora* in creek: Cheyenne, Wyo.

GLOSSARY

Ala. Pl. *alae.* A wing. The same as carina or keel, in *Surirella,* etc.

Auxospore. The spore formed by the union of two cells, or the excessive growth of a single cell forming a new diatom larger than the parents.

Carina. Keel; the wing-like projection on a diatom valve.

Connecting zone. The portion of a diatom cell wall between the valves; the girdle.

Convergent. Pointing toward raphe at the ends, as the striations in some species of *Navicula.*

Costa. A rib; heavy markings on a diatom valve not consisting of rows of dots.

Decussate. From Lat. *decussatus,* crossed at acute angles like the letter X. Crossing one another in three directions as the striations in some species of *Gyrosigma.*

Diatomin. The coloring matter of diatoms. It is composed of phycoxanthin and chlorophyll.

Dorsal. The back, or outer side of a curved diatom.

Endochrome. The chromatophore of a diatom.

Frustule. An entire diatom cell including the valves, girdle, and contents.

Fenestrated. (Lat. *fenestra,* window.) With window-like openings.

Girdle. The portion of a diatom cell wall that connects the valves.

Interzone. A band between the portion of the girdles attached to each valve. In some genera there are no interzones; in others, one; and in others, two or more.

Keel. The same as *carina.* A wing-like projection on a diatom valve.

Lumen. A clear space at the margin and ends of a diatom cell caused by a thickening of the wall; seen in some species of *Stauroneis.*

Naviculoid. Shaped like a *Navicula;* boat-shape.

Nodule. A thickening in a diatom valve. In *Navicula,* for example, the nodules appear as dots in the center and at the ends.

Perizonium. The thin, unsilicified membrane of a young auxospore.

Phycoxanthin. The brown coloring matter of diatoms.

Pseudoraphe. A clear longitudinal space in a diatom valve; same as rachis.

Pseudostauros. False stauros. The appearance of a stauros in the center of a diatom valve caused by the striations being absent, and not by the widening of the central nodule.

Punctate. Consisting of rows of puncta or dots.

Punctum. Pl. *puncta.* A point or dot. The striations of most diatoms consist of rows of puncta.

Rachis or **rhachis.** A longitudinal line on a diatom valve in which there are no striations.

Raphe. A longitudinal slit in a diatom valve. It is the central line in *Navicula* and allied genera.

Stauroneiform. Having the form of a stauros or cross.

Stauros. The transversely elongated nodule as in *Stauroneis.*

Sulcus. Pl. *sulci.* A groove or depression in a valve.

Valve. One of the halves of the silicified cell wall of a diatom.

Ventral. The inner side of a curved diatom, opposed to dorsal.

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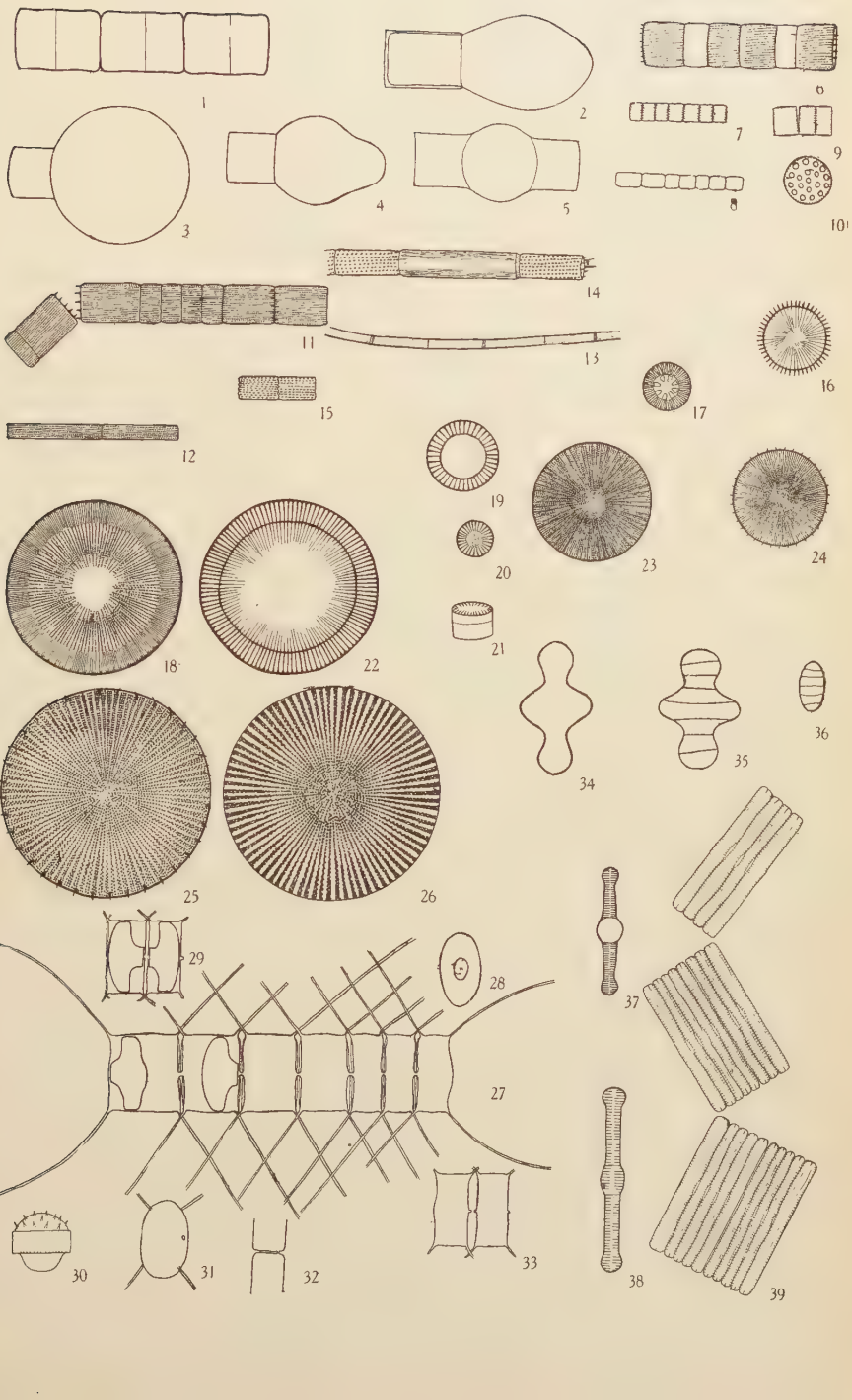

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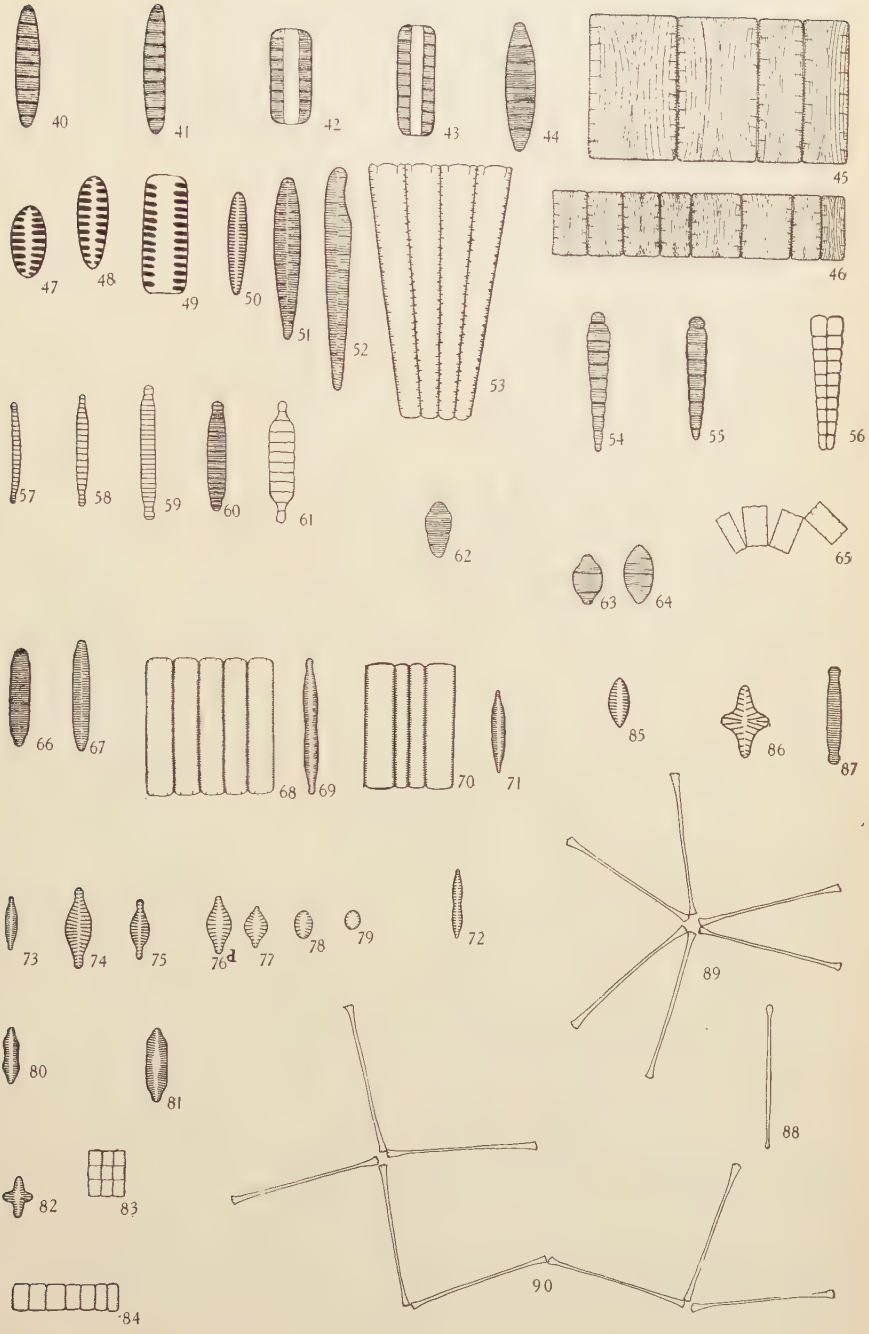
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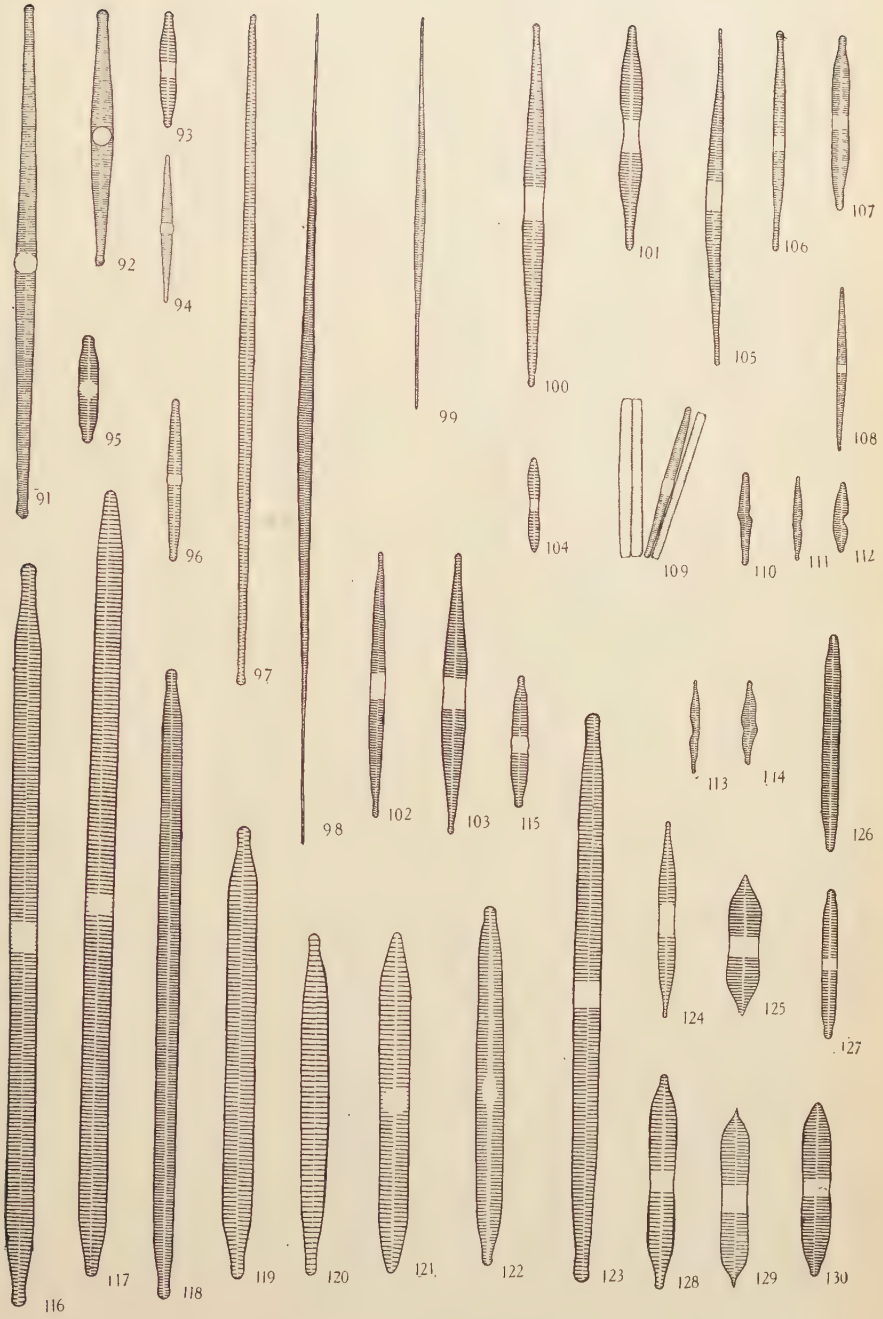
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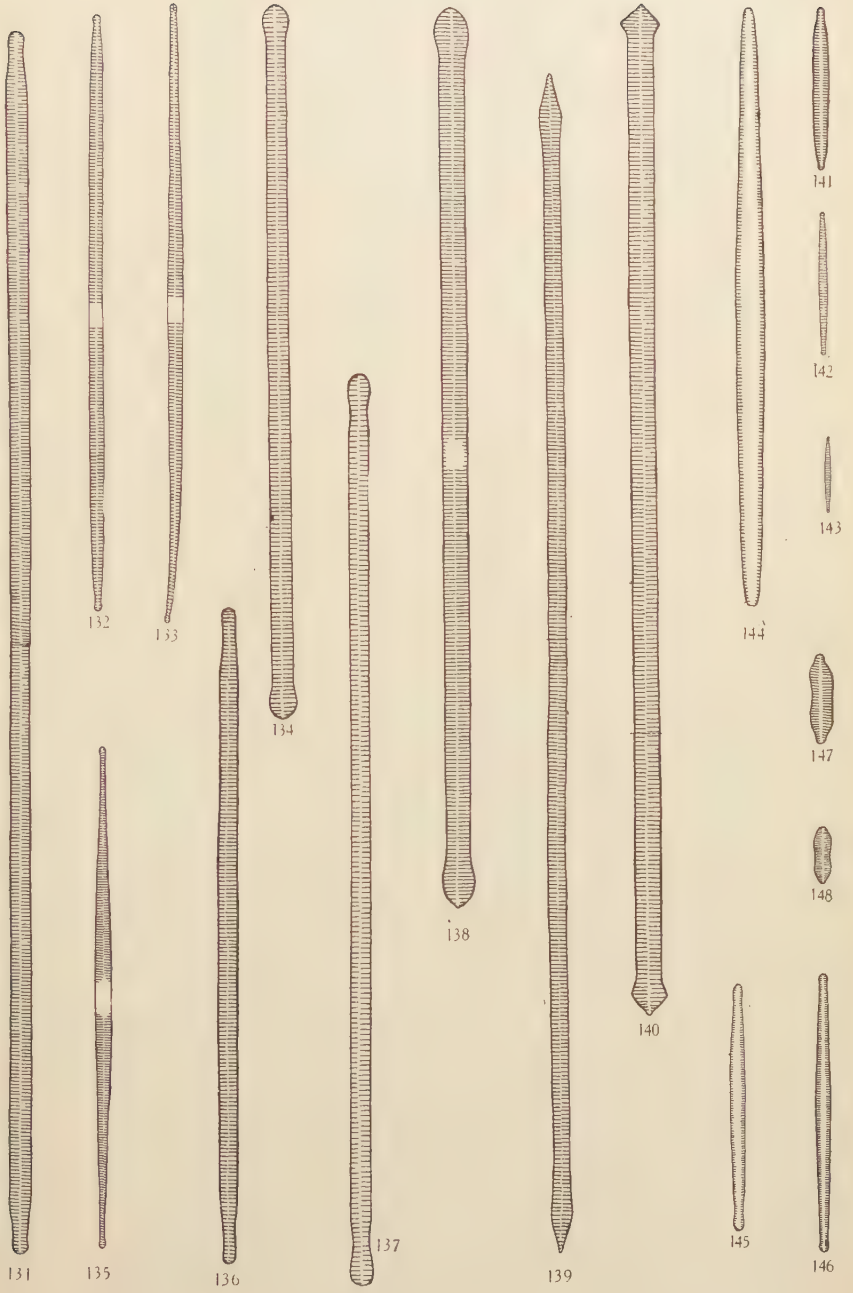
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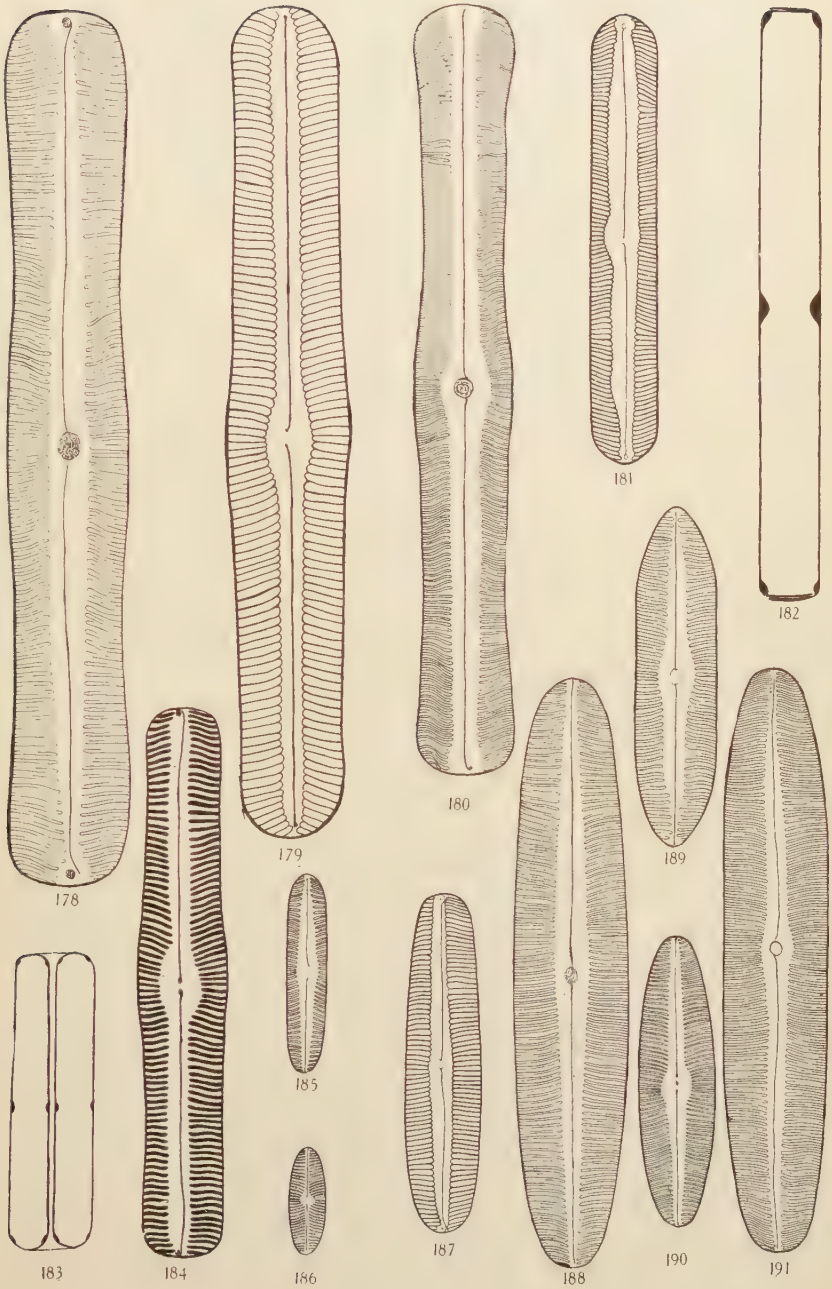

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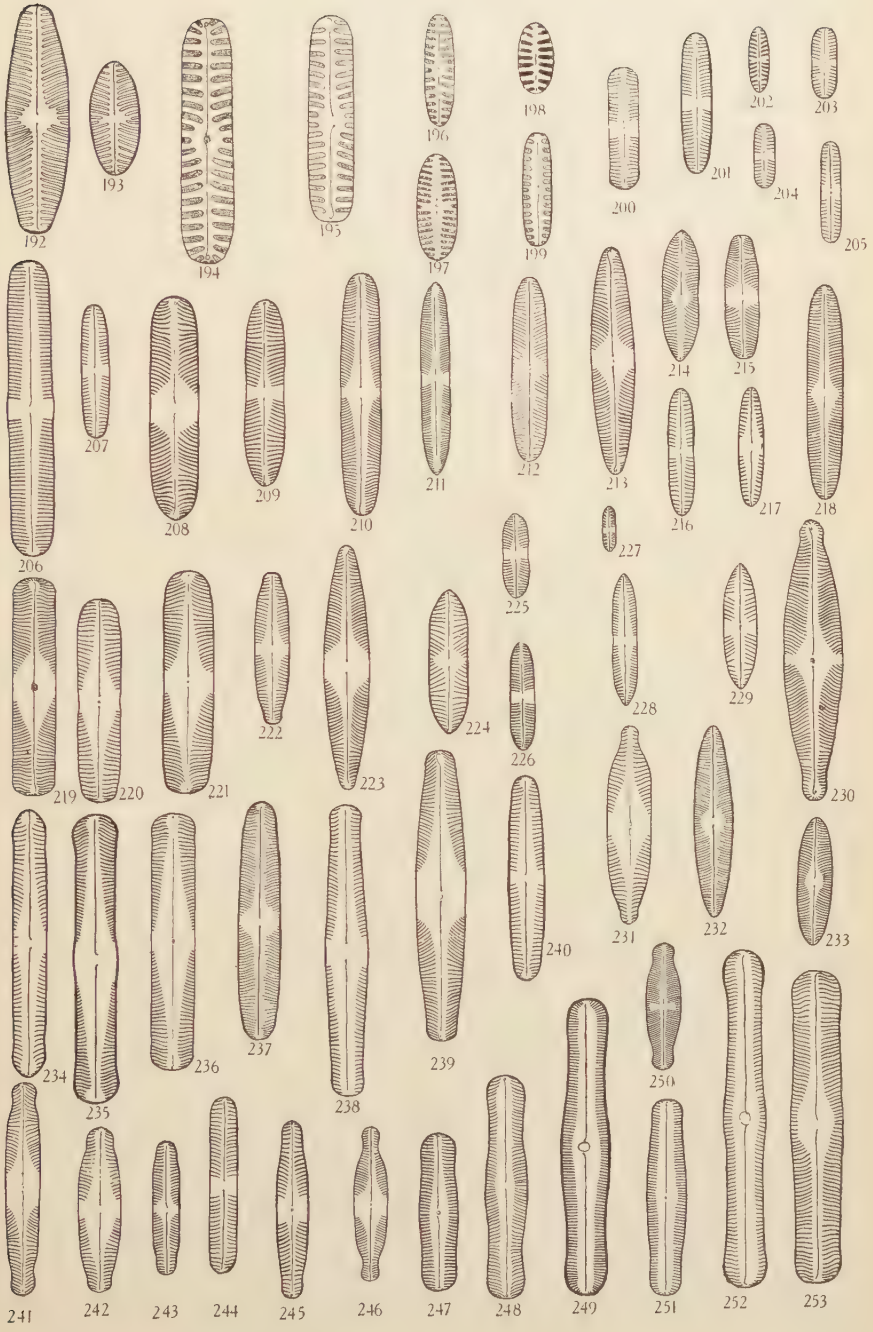
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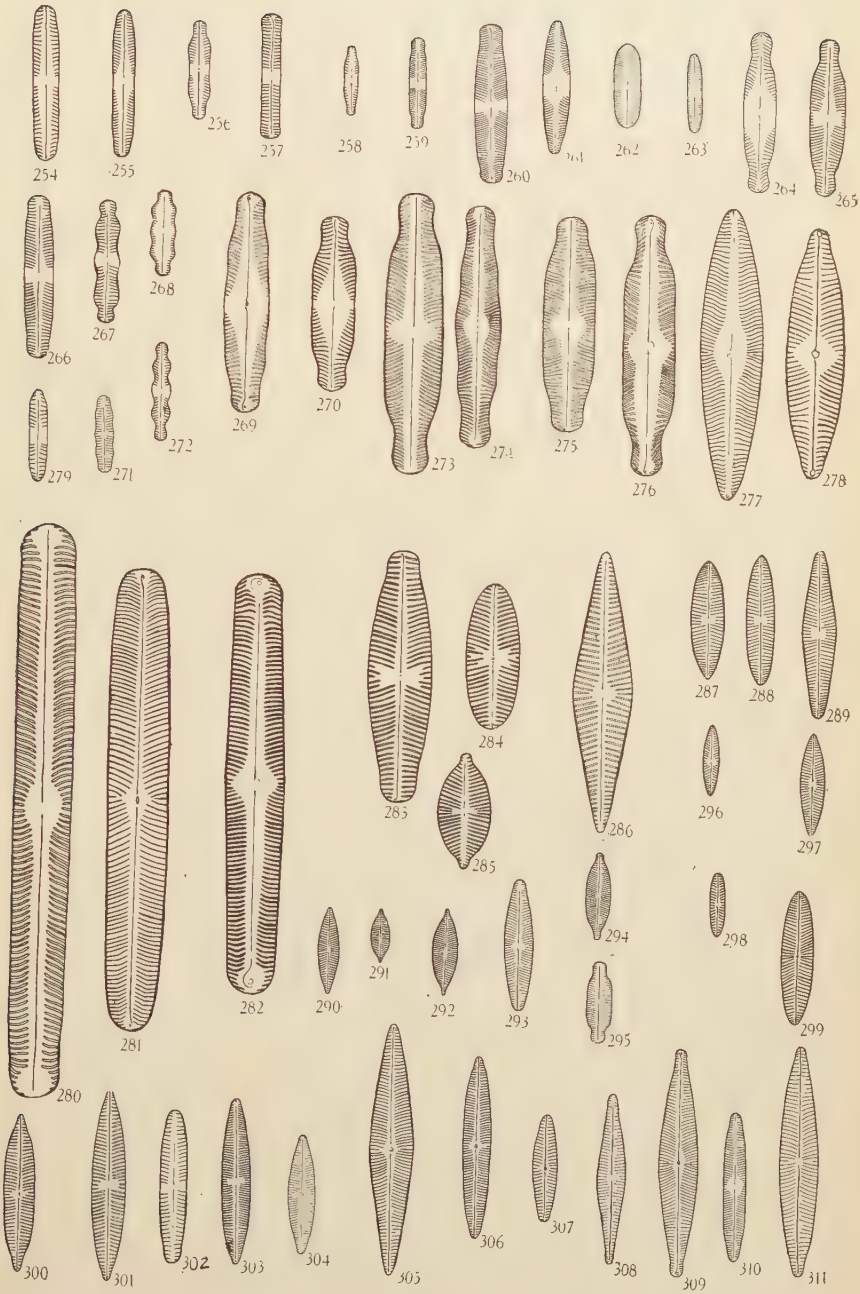
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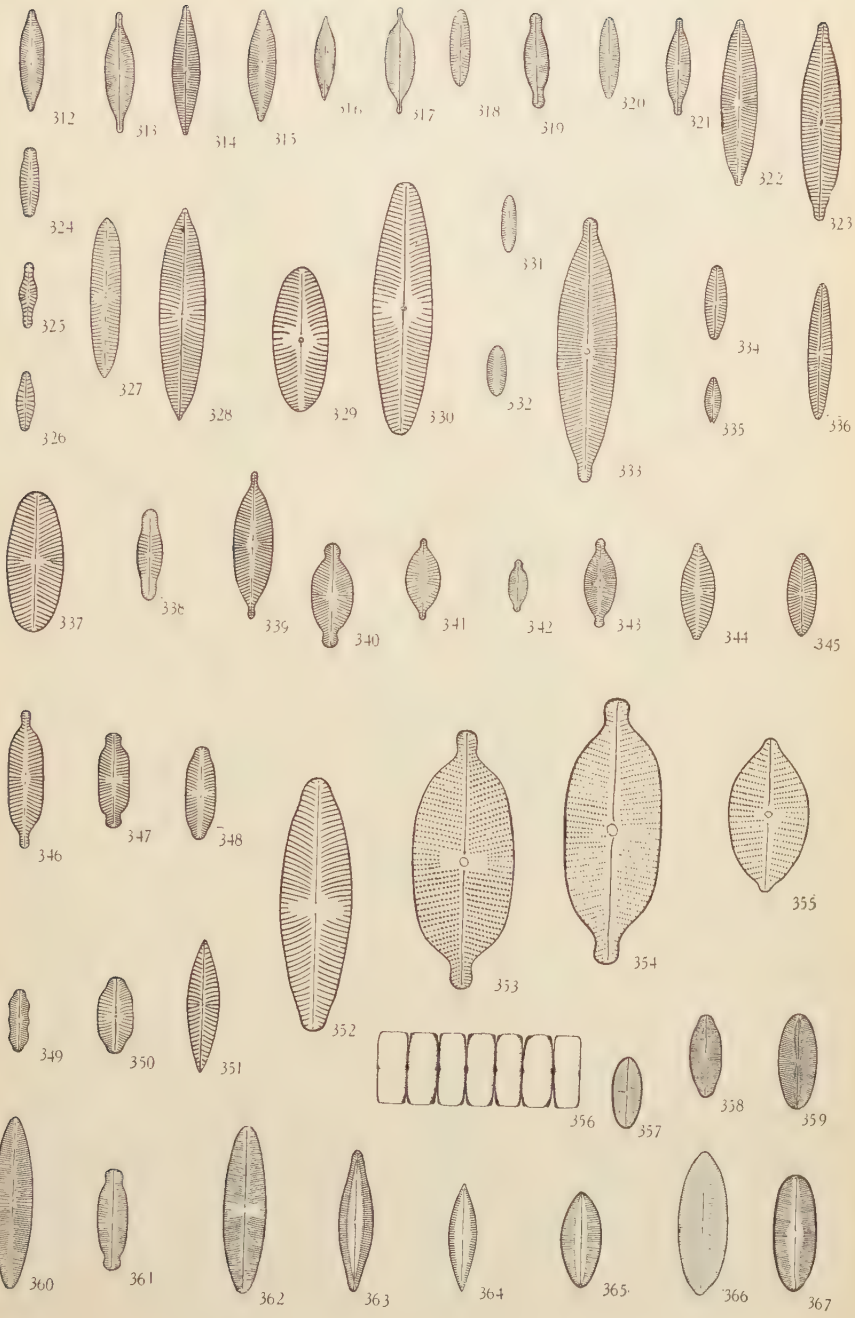
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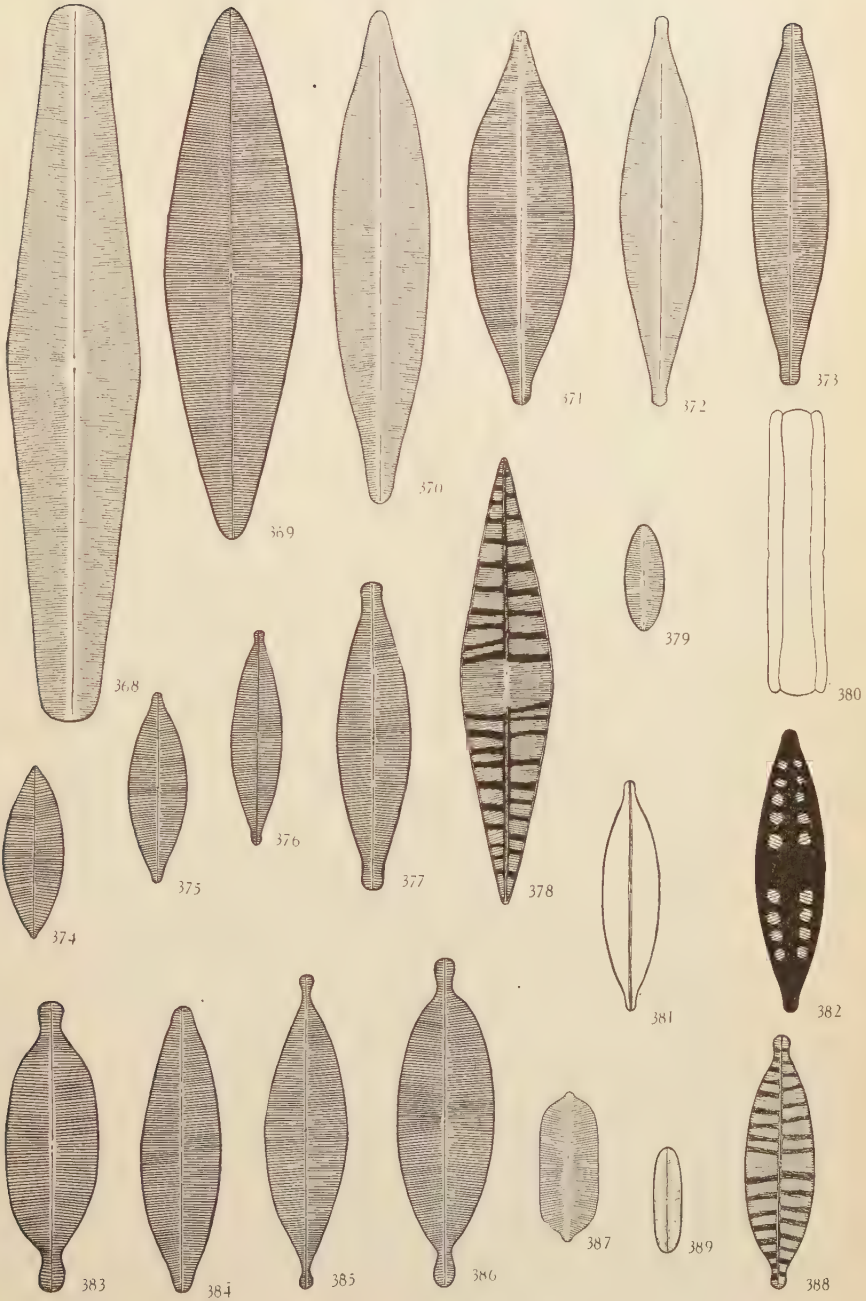
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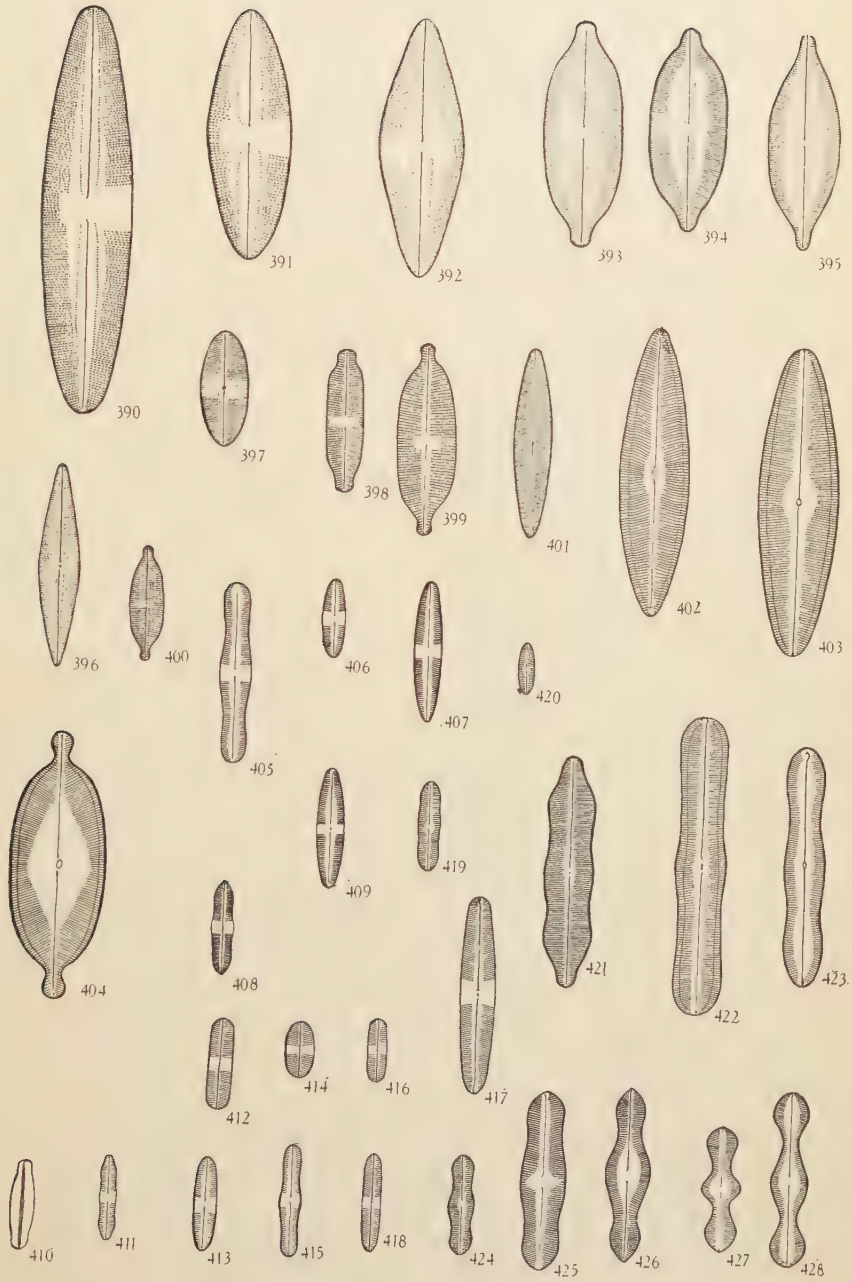
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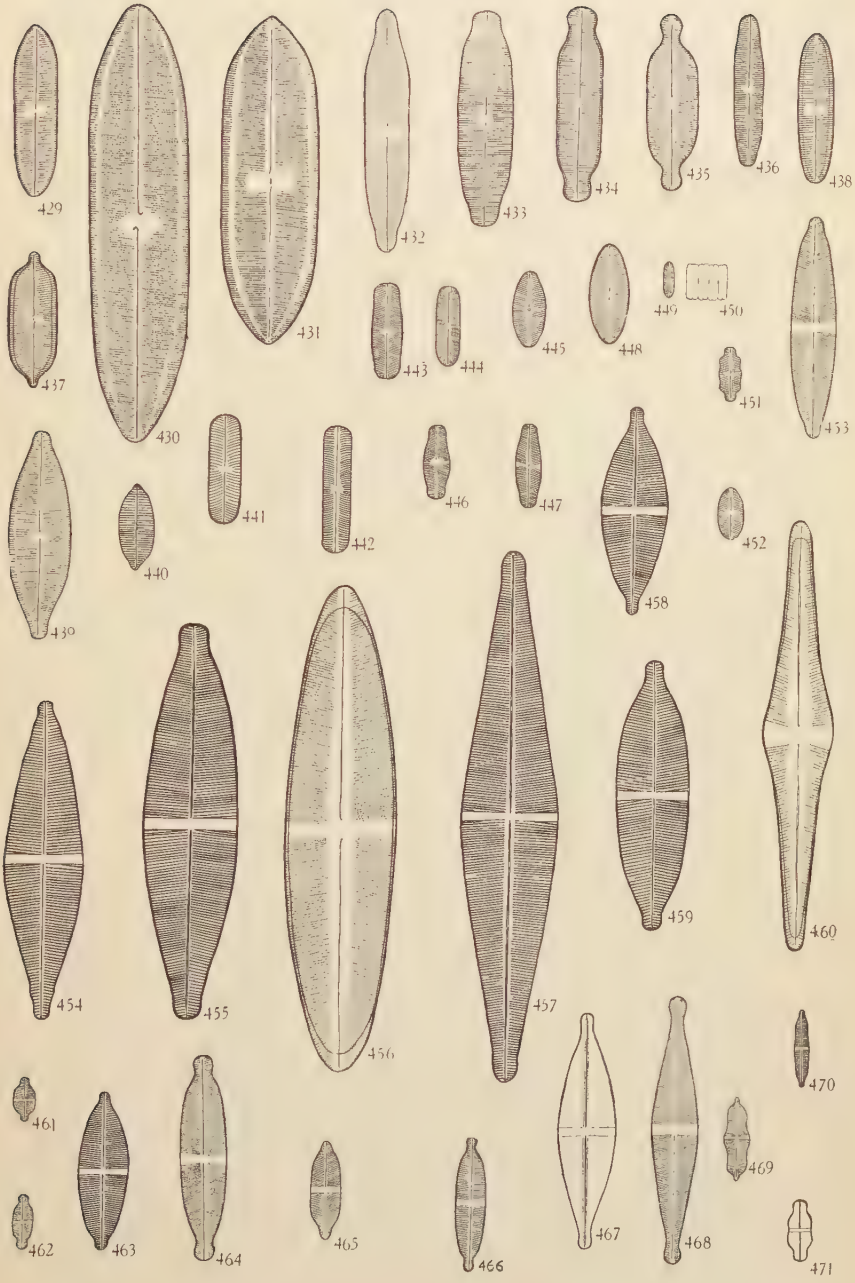
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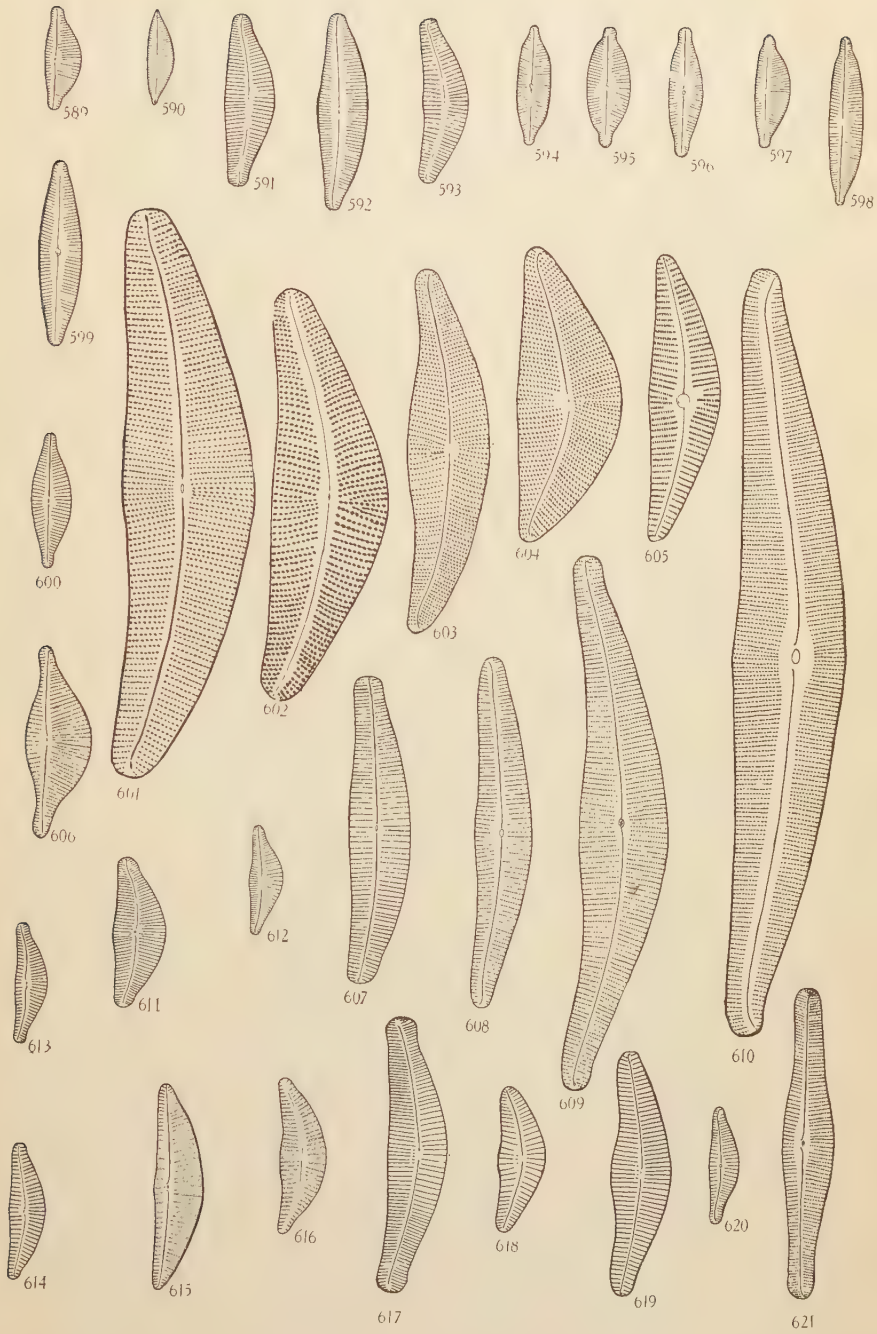
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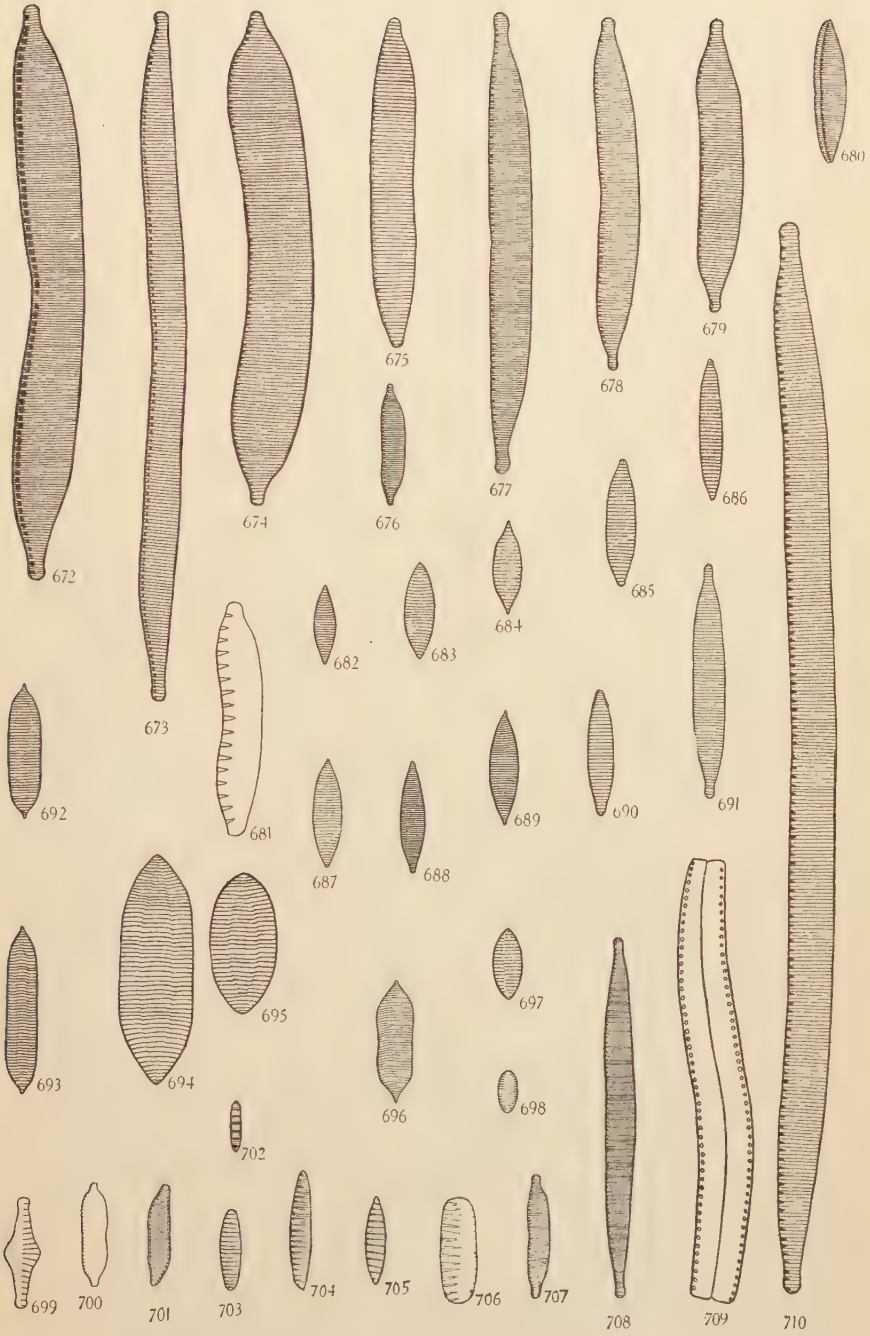
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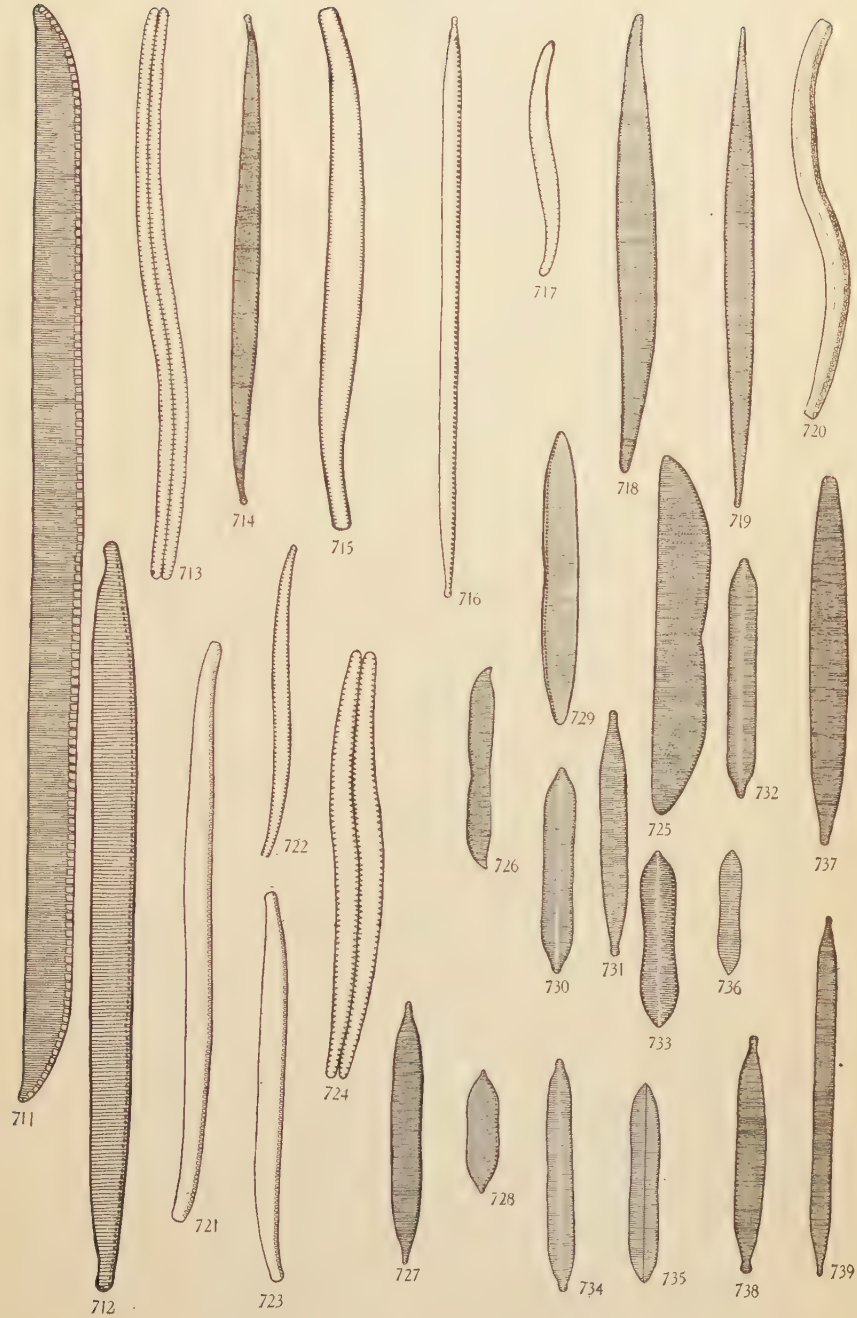
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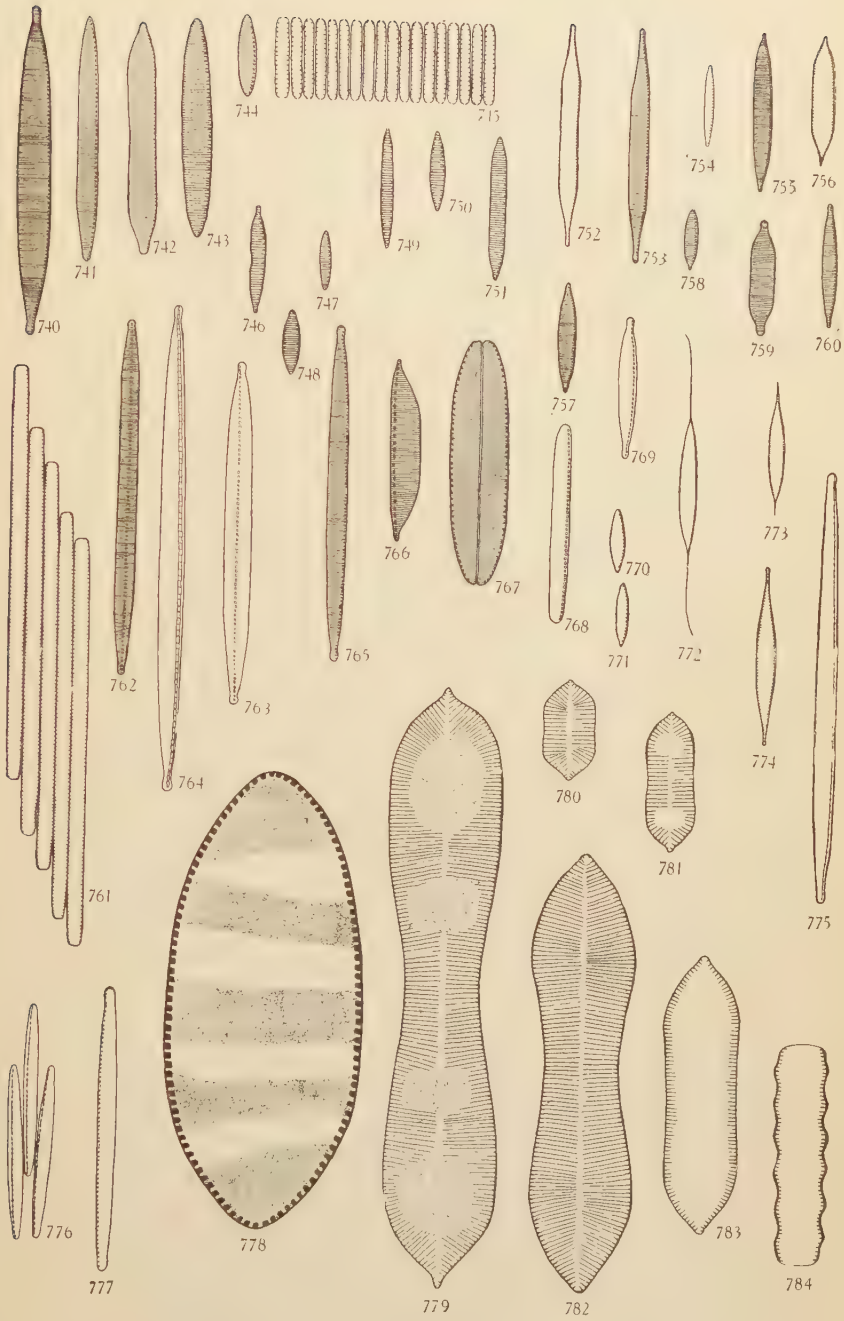
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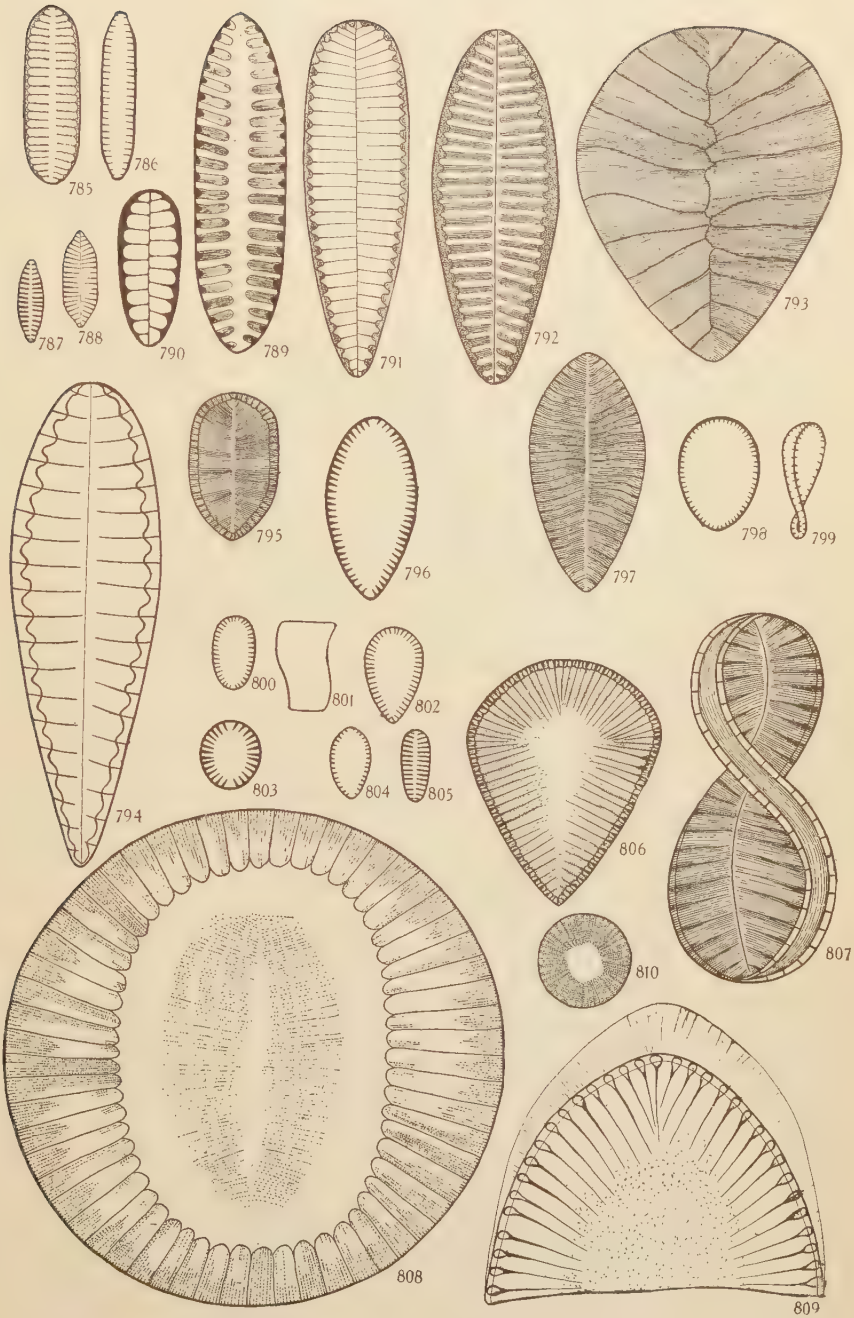
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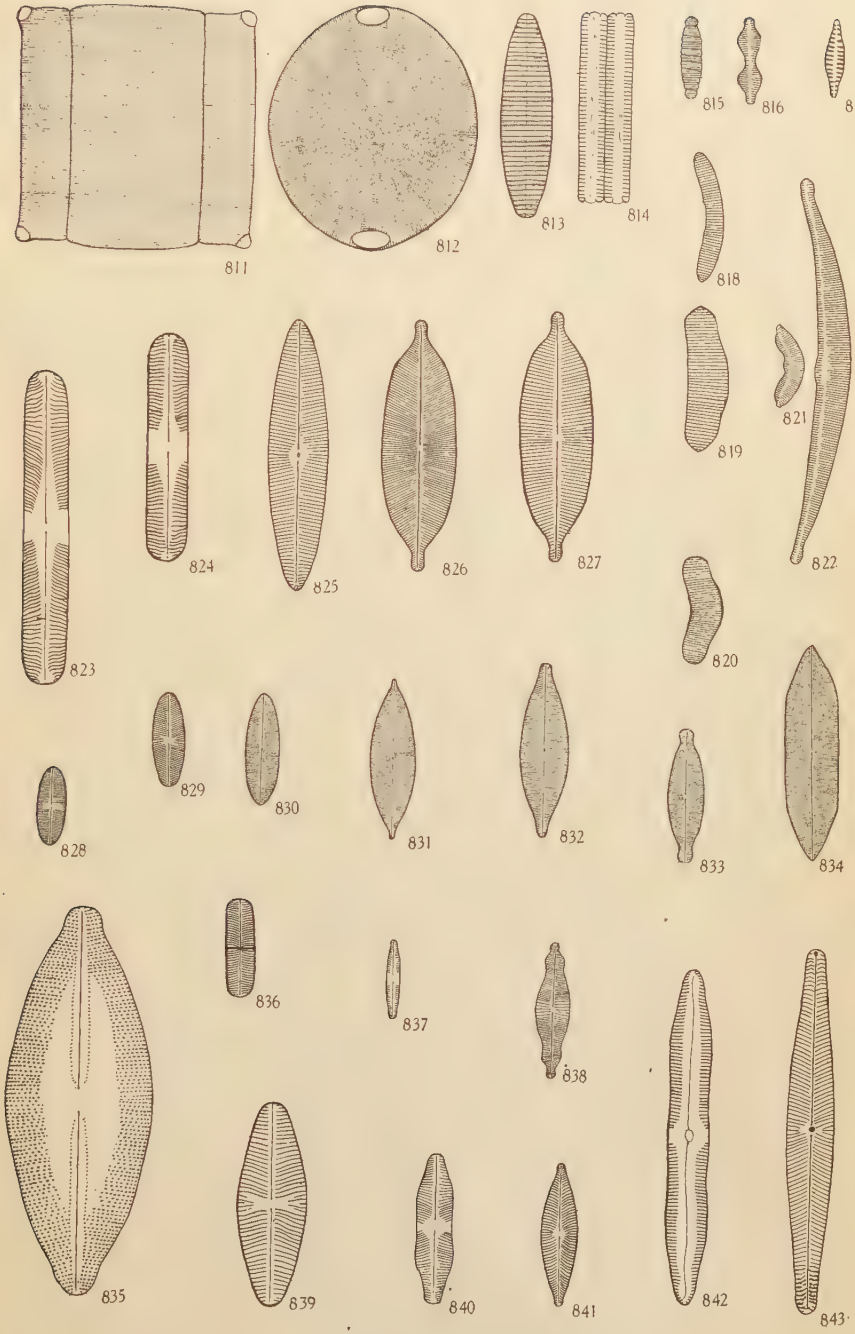
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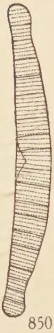
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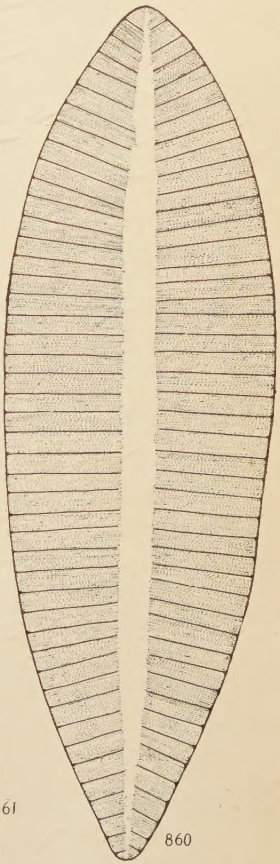
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